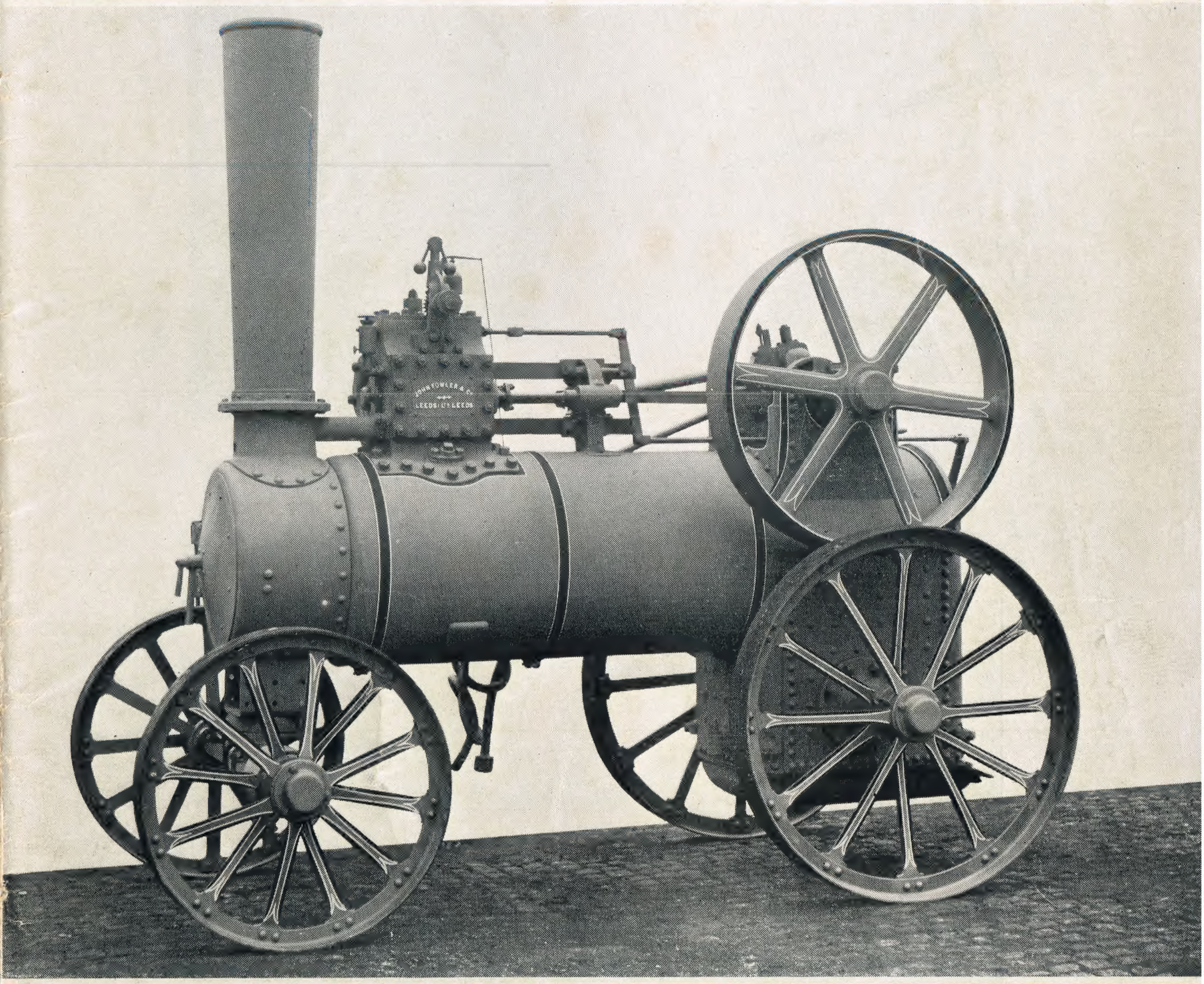
THE MODEL ENGINEER

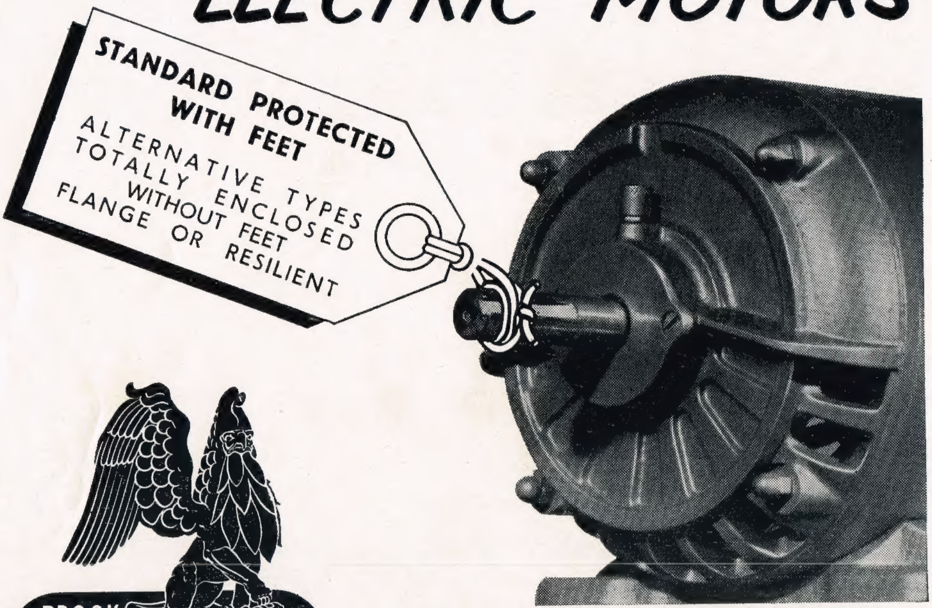


IN THIS ISSUE

- A PORTABLE COMPRESSOR SET
- A REVERSING SWITCH FOR ELECTRIC MOTORS
- AN ELECTRONIC STROBOSCOPE
- TYPES OF CENTRIFUGAL PUMPS
- FOOTPLATE FITTINGS FOR L.B.S.C.'s "NETTA"
- AN ALL-FABRICATED HEADSTOCK

JUNE 23rd 1955
Vol. 112 No. 2822
9D

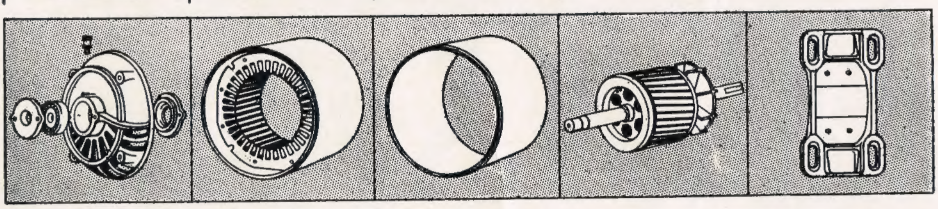
FACTS ABOUT ELECTRIC MOTORS



BROOK GRYPHON
FRACTIONAL HORSE POWER MOTORS

ATTRACTIVE FINISH

BALL OR SLEEVE BEARINGS AT THE SAME PRICE



BEARINGS	STAMPINGS	STEEL SHELL	ROTOR	FEET
Super silent ball bearings fitted as standard.	Pressure assembled pack ensures a rigid stator winding.	3/16" rolled steel shell makes a stout outer frame.	Pressure cast aluminium rotor, dynamically balanced to give vibration free running.	Accurately machined cast iron feet. Firmly fixed but easily detachable.

BROOK MOTORS LIMITED
HUDDERSFIELD

55/5

1,000,000 Steel and Brass Precision Screws as used on instrument work, mostly steel, sizes 2, 3, 4, 5, 6, 7, 8 B.A. various standard type heads. This is a really useful bargain. 4-gross ass. 4/9 the lot, in tin box, postage 6d. Just think—precision screws at a penny a dozen. 5 lots 21/-, post paid. 20 lots £3-10-0.

50,000 Steel Grub Screws, precision cut threads, not cheap rolled type. Sizes 0, 1, 3, 4, 5, 7 B.A. 3-gross ass. 3/6, in tin box, postage 6d. 6 lots £1, post paid. 20 lots £2-10-0.

200 H.S. Morse Taper Shank End mills. No. 1 shank 1/4", 5/-, 5/16", 5/6, 1/2", 7/6 each. No. 2 shank 5/8", 10/-, 3/4", 12/-, 7/8", 12/- each. Also straight shank H.S. 3/8", 4/-, 1/2", 5/-, 5/8", 7/6, 3/4", 10/-, 1", 12/6 each.

500 sets 13/16" dia. split dies 1/8", 5/32", 3/16", 7/32", 1/4" Whit. 7/6 per set, taps to suit in either T.,S. or P. 4/3 set. 3 sets 12/-. Die stock 2/9. Adjustable tap wrench 2/3.

1,000 H.S. long straight shank twist drills 3/64" to 7/64" dia. 4"-6" long, 3 ass. 5/-; approx. 7/32" and 1/4" dia., 6" and 7" long, 5/- the two; 9/64" dia. 11" long, 9" flute length, 3/6 each; .2" dia., 10" long, 8" f.l. 4/6 each; 19/64" dia. 9" long, 7" f.l. 4/6 each.

500 thin Side and Face Cutters 1 1/4" hole, 5" dia., 3/32", 1/8", 1/4" thick, 25/- each. 6" dia. 7/32", 3/16" thick, 30/- each. 7" dia. 3/16", 7/32" thick, 35/- each. 8" dia. 3/32", 1/8", 5/32", 3/16" thick, 40/- each.

50 pairs small H.S. Side and Face Cutters 2" dia., 3/16" thick, 3/4" bore. Teeth cut on face: one cutter right side, other cutter left side. Very useful, cheap 15/- pair.

150 No. 2 Morse Taper Socket Extensions, 8" long, comprising No. 2 morse taper, ground finish at one end and No. 2 morse taper internal at other end, worth 15/- each, clear 5/- each.

500 High Speed Side and Face Cutters, 2 1/2" dia., 1" hole, 1/4", 3/8", 1/2" thick, 10/- each; 3" dia., 1/2", 5/8" thick, 15/- each; 3 1/2" dia., 5/16"; 3/8"; 3/4" thick, 17/6 each; 4" dia. 7/8", 1" thick, 25/- each. All 1" hole.

500 Sets Figure and Letter Punches for steel marking, size 1/4", gift, figures, 5/-, letters 15/- per set.

1,000 B.A. Hand Taps, Sizes 0, 2, 4, 6, B.A. in tapers, seconds or plugs, 1/- each, 10/9 per doz., any size or sizes.

50 High Speed Shell End Mills, 2" dia., 1 3/4" wide, worth 62/- clear 15/- each; ditto, 2 1/4" dia., 2 1/4" wide, 20/- each.

1,500 H.S. Morse Taper Shank Twist Drills. Brand New, Firth Speedicut, Balfour Capital, etc. This is an opportunity to secure a really good range of sizes at about a quarter of fractional size cost. No. 2 Morse Shank, 14 mm., 4/6. 16 mm., 5/-, 17 mm., 5/6, 17.5 mm., 18.5 mm., 6/- each. 19 mm., 20 mm., 20.5 mm., 21.5 mm. 6/6 each. 22 mm. 7/- each. No. 3 Morse Shank, 23.5 mm., 24 mm., 24.5 mm., 8/- each. 26 mm., 26.5 mm., 9/- each. 27 mm., 27.5 mm., 10/- each. 28 mm., 29 mm., 29.5 mm., 11/- each. No. 4 Morse Shank, 40 mm., 30/- each. We strongly advise our clients to secure a stock as early as possible.

This is a H.S. Milling Cutter Bargain. All 1" bore, 3"-3 1/2" dia., 1/4"-3/4" thick, including side and face cutters, plain and angle cutters. A most useful lot for any tool room, 6 ass. for 50/-. The present maker's price of the cheapest cutter in this selection is 40/-. You must get this lot, remember you get same on approval against cash.

300 H.S. Counterbore Drills, 13/32" dia. pilot drill, 5/8" counterbore drill. No. 1 M.T. shank, 7/6 each.

350 Interlocking Cutters, side and face, 3" dia., 1" hole, 3/4" wide. Two separate cutters, bargain 20/- pair. Actual value £5.

2,000 Small H.S. Twist Drills, approx. 1/32"-3/32", 4/- doz. approx.; 1/16"-1/4", 7/6 per doz. approx.; 9/32"-15/32" six for 10/-.

All items brand new. £1 orders post paid. Prompt delivery Inspection by appointment only. All items sent on approval against cheque or P.O. Refund without question if any item returned.

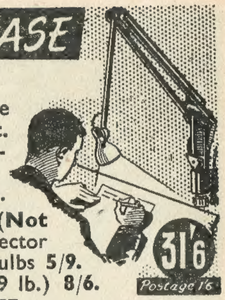
3,000 Circular Split Dies 1" dia. cutting 1/4", 5/16", 3/8", 7/16", 1/2" Whit., B.S.F., also brass thread, 26 thread all sizes and American N.F. 12/- per set of 5 sizes, 2 sets 22/6, 4 sets 42/6. Taps to suit 9/3 per set, either taper or second or plug. 1" die-stocks 5/- each; 3/16" to 1/2" tap wrenches 12/6 each.

J. BURKE

192 Balsow Road, Totley, Sheffield

Inspection Only at Rear 36 Fitzwilliam St., Sheffield

SPECIAL PURCHASE



TERRY LAMPS
Ex A.M. spring-friction Anglepoise type with pygmy reflector and s.b.c. holder. Wall/bench fitting—UNUSED and perfect 31/6. Under half cost. Post extra 1/6.

EXTRAS NOW AVAILABLE (Not Terry Products) Larger Reflector and b.c. holder for all standard bulbs 5/9. Cast Iron Table Base (weight 9 lb.) 8/6.

MONEY BACK GUARANTEE

CHARLES FRANK

67-73 SALTMARKET, GLASGOW, C.1

Est. 1907 Phone: Bell 2106-7

WE ARE GIVING A PRIZE OF £10 AT THE NEXT "M.E." EXHIBITION FOR THE BEST EXHIBIT MADE FROM OUR STANDARD SETS OF PART-MACHINED CASTINGS. IF YOU WISH TO ENTER, PLEASE APPLY TO US FOR ENTRY FORMS.

If you wish to purchase a set of parts for the construction of a drilling machine, hand shaper or compound table, you will have time to enter for the competition if you order now.

E. W. COWELL LTD.

7a, SYDNEY RD., WATFORD, HERTS

"CALEY" SPECIALITIES

"Caley" universal cutting oil 2/- post 8d. (makes one gallon).
"Caley" super diesel fuel 2/6 post 8d. (First 1946—still best).
"Caley" special lathe oil, 2/- post 8d. "Caley" super steam oil 2/- post 8d.
"Caley" steam packing 1/16 rnd. 1½d., 1/8 rnd. 3d., 1/4 sq. 7d. per ft., post extra.
"Caley" solenoid motor, 12/6. "Caley" 3-lever frame to suit 7/6.
"Caley" blue marking fluid 1/6 post 6d.

NEW MICROMETERS ONLY 10/-

Everything for the Aircraft, Railway, Ship and R/C Enthusiast.

No Catalogue meantime. S.A.E. all enquiries

PATTERNMAKING CASTING MACHINING

CALEDONIA MODEL Co.
5 PITT STREET GLASGOW C.2
Corner of 46B Argyle Street

"No Quantity Too Small"

BRASS, COPPER, BRONZE, ALUMINIUM, LIGHT ALLOYS

IN

Rod, Bar, Sheet, Tube, Strip, Wire, Angle, Channel, Tee.

H. ROLLET & CO. LTD.

6, Chesham Place, London, S.W.1
SLOane 3463

Works:
32-36, Rosebery Avenue, London, E.C.1

BRANCHES AT
Liverpool Manchester Birmingham Leeds

THE
MODEL ENGINEER

ESTABLISHED 1898

SMOKE RINGS

Managing Editor E. F. H. COSH

Technical Editors
J. N. MASKELYNE, A.I.Loco.E.
E. T. WESTBURY
E. BOWNESS, A.I.N.A.

Features Editor J. D. McLINTOCK

Advertisement Manager T. C. PAGE

Volume 112 - No. 2822
June 23rd - 1955

CONTENTS

OUR COVER PICTURE

Among the many photographs of portable engines that have been sent to us by readers, in recent years, the very striking-looking design by John Fowler & Co., of Leeds, has been conspicuous by its absence. Mr. A. L. Palmer, of Melton Constable, Norfolk, has sought to fill the gap by sending us a copy of an official photograph of one of these very handsome little engines, and we think it will interest many readers. As will be seen, the engine very closely resembles a traction engine in looks.

The "M.E." Gets There

IN COMMON with most other popular periodicals, THE MODEL ENGINEER was presented with an outsize problem of delivery, as a result of the railway strike. But problems are meant to be solved, and readers who obtain their copies of THE MODEL ENGINEER from local newsagents may be interested to know that the arrangements which we made have been so successful that practically no delay has occurred in the distribution of supplies to towns throughout the British Isles.

Parcels of copies which would normally be sent by rail to wholesale newsagents have been delivered by road, in our own vans and staff cars. Supplies for Scotland have been sent by air, from Blackbush Airport to Glasgow, and thence distributed by road. Consignments for Ireland and the Channel Islands have been going by road to Liverpool and Southampton, respectively, and then shipped direct. So far as we know, all copies have arrived at their destinations within a few hours of normal time.

Aluminium Centenary

ONE HUNDRED years ago, a sample of aluminium was exhibited by Faraday at the Royal Institution; the early attempts by Sir Humphrey Davy, at the beginning of the nineteenth century, to produce this metal from its oxide, alumina, were not completely successful, but they focussed the attention of metallurgists on this problem, and paved the way to ultimate success. When first commercially produced, aluminium was sold at about £7 per pound, thus ranking as a precious metal, and its application was confined to ornamental purposes such as miniature statuary and other *objets d'art.* Its development for engineering and structural purposes, however, followed rapidly on new processes which cheapened its production, and the discovery, about the beginning of this century, that aluminium alloys as strong as mild-steel were possible, gave an indication of vast possibilities for all purposes where strength with lightness is essential. The most obvious of these was in the rapidly growing automobile and aircraft industries, and no reminder is necessary of the part which it has played, and is still playing, in these fields of engineering. But its advantages have been realised in a far wider range of industries than this, and at the Aluminium Centenary Exhibition held recently by the Aluminium Development Association, some striking examples of its use in a wide range of modern products, from locomotives to lathes, bridges to brewer's vats, and jet engines to jewellery, epitomised the remarkable progress in the use of an element which was little more than a scientific novelty a hundred years ago.

Health Through Model Engineering

IN REHABILITATION after serious illness or injury, the value of some form of occupation to exercise and assist in restoring both physical and mental faculties is beyond question, and what is known as "occupational therapy" is now an established part of the treatment of convalescents in hospitals and clinics. The benefits thus obtained are still further enhanced if the kind of occupation chosen is both interesting and creative; in this respect, model engineering in one or other of its various branches has a strong claim to attention, and has been recommended by several doctors. We have also received many letters in the past from readers, telling us how their recovery from illness has been speeded by "pottering about" with model work, even if it had to be carried out from the depths of an armchair or even on a bedside table. We are reminded of this in a recent letter from a reader in the St. Albans district, who informs us that one of his friends, (ex R.N.) who is recovering from a spinal injury which will stop him from carrying on normal work for some time, is attempting to complete a metre cruiser, and has asked the said reader to try and find him a steam engine for it. Our help in this worthy cause has been requested, and we are glad to pass on this appeal; some of our readers may have an engine of a suitable type lying idle—condition is no object—and if so, we shall be pleased to pass on any offers received to the appropriate quarter.

Published every Thursday by PERCIVAL MARSHALL & COMPANY LTD., 19-20 NOEL STREET, LONDON, W.1
Telephone: GERrard 8811 Annual Subscription £2.2s.0d. post paid. (U.S.A. and Canada $6)

AN ELECTRONIC STROBOSCOPE

By L. V. Raxworthy

VALUABLE information can be obtained of the motions of mechanisms which are running too fast to be seen by the unaided eye, by the aid of the stroboscope, which has the property of making revolving machinery appear stationary, or oscillating or reciprocating mechanisms can be made to appear to run slow enough to be easily seen, and the effects of wear, or other abnormality such as valve bounce, will be shown up.

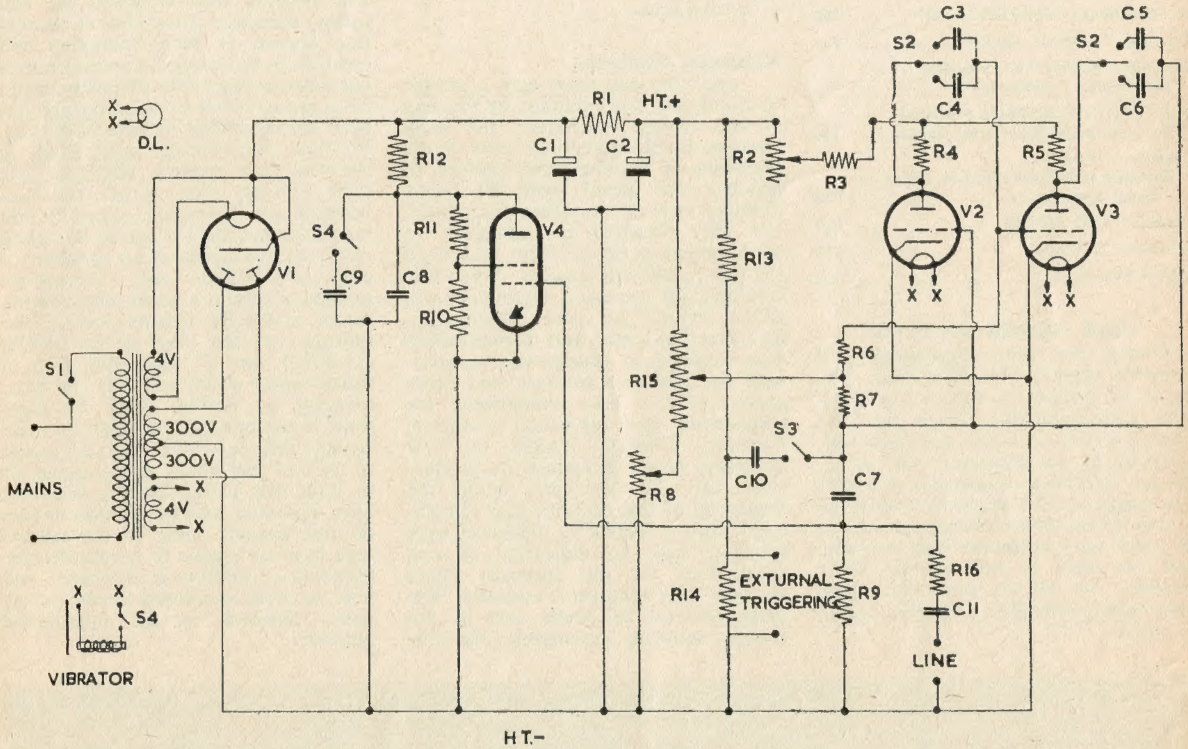
With a calibrated stroboscope, the exact speed of any rotating mechanism can be measured by adjusting the speed of the lamp until the mechanism appears stationary; the speed can be read off from the scale on the dial.

Torsion and whip of shafts can be measured, also gear meshing, propeller balancing, and many other applications too numerous to mention. The stroboscope is, therefore, a very useful piece of equipment for any model club, and will be found very worth while the effort of making.

The range of speeds covered by the stroboscope is from 500 to 18,000 r.p.m.; this is done in two steps, the low range being from 500 to 3,200 r.p.m. and the high range from 3,000 to 18,000 r.p.m. The change from low to high range is made by means of a multi-channel switch, such as a " Yaxley " switch, which connect alternate condensers in the circuit, thus altering the capacity, the rule being, the lower the capacity, the higher the rate of flashing of the lamp. The intermediate speeds are controlled by a large variable resistance; it is the dial of this resistance which is calibrated to read off in r.p.m.

The method of mounting the components can be left to the builder, depending on the case or cabinet it is to be housed in, the general arrangement is very flexible.

The author at the controls



The circuit diagram

It will be seen from the circuit diagram, and list of components Table I, that anyone familiar with radio, should have no difficulty in constructing the stroboscope.

It will be seen that the large variable resistance (R.15) is of the order of 25 watts rating; this may seem to be unduly large, and one may be tempted to use a resistance of smaller rating in its place, but as this is the calibrated resistance, controlling the frequency of the flashing of the lamp, and also taking the whole of the current of the circuit, it is essential for stability and long life that a type capable of dealing with ample current is used.

Referring to the diagram, V4 is the Neostron lamp, in other words, the stroboscopic lamp, which is triggered by a multi-vibrator oscillator V2 and 3 and a power unit. The vibrator is used as a means of checking the calibration, and is put into circuit by means of S.3.

The two ranges, 500 to 3,200 and 3,000 to 18,000 are brought about by switch S.2, which has three positions. The central position throws the oscillator out of circuit the left position connects C9, C3 and C5 for low range, and the right position connects C8, C4 and C6 for high range.

There are two pairs of terminals marked " Contacts " and " Line "; these are used as follows:—

Contacts

When a rotating or reciprocating machine or apparatus, which is erratic in operation, is required to be " strobed," it would be practically impossible to adjust the stroboscope to obtain a steady impression, so a pair of contacts are fitted to the machine in such a way as to make contact at each revolution, these are connected to the " contact " terminals; this arrangement will trigger the lamp, so presenting a steady impression of the component, making it apparently stationary.

These terminals are used to trigger the lamp by the mains supply, which will cause the lamp to flash at 50 c.p.s. For this purpose, a step-down transformer is used, to bring the voltage down to about 40 volt. This will be found useful when testing mechanical tachometers.

A general view of the stroboscope

Before switching on to either contact or line circuits, the change-over switch must be put to the off position, and the calibrated potentiometer R.15 to its highest point, with switch S.3 closed, thus completing the circuit for triggering the lamp.

Calibrating

Having completed the stroboscope, and tested out the circuits, it is now ready for calibrating. This is done by the use of a constant-speed motor of 3,000 r.p.m. A two-pole synchronous motor will be ideal for the job.

On the end of the shaft, a black disc is fitted, and on this disc a white mark or line is put which will act as a reference, or checking mark.

On switching on the motor, the mark will disappear in a blurr; now switch the " strobe " on, shine the lamp on to the disc, and adjust R.17 until the white

R1	3,500	ohms 3 watt	R9	1 M.	ohms ½ watt
R2	30,000	„ 1 „	R10	10,000	„ ½ „
R3	30,000	„ ½ „	R11	50,000	„ ½ „
R4	100,000	„ ½ „	R12	2,500	„ 5 „
R5	100,000	„ ½ „	R13	50,000	„ ½ „
R6	1 M.	„ 1 „	R14	100,000	„ ½ „
R7	1 M.	„ 1 „	R15	10,000	„ 25 „
R8	1,500	„ 1 „	R16	100,000	„ ½ „
C1	8 u.F.	500 V.W.	C9	2 u.F.	350 V.W.
C2	16 u.F.	„ „	C10	0.1 u.F.	„ „
C3	0.02 u.F.	350 „	C11	0.25 u.F.	„ „
C4	0.005 u.F.	„ „	V1	U.U.5	Mazda
C5	0.02 u.F.	„ „	V2	354 V.	Mullard
C6	0.005 u.F.	„ „	V3	„	„
C7	0.0005 u.F.	„ „	V4	NSP.1	Ferranti
C8	1 u.F.	„ „			

TABLE I

mark appears stationary; this will mean the lamp is flashing at the same speed as the motor is revolving, and the first calibrations can be made at 3,000 r.p.m.

At other speeds of the lamp, a multiple number of white marks will appear on the disc, and from these the calibrations can be completed.

It will be seen from Table 2 which speeds the number of marks represent. As it is not very easy to count the higher number of marks, a special disc may be made with a number of concentric rings, each having a given number of equally-spaced white marks. As the speed of the "strobe" is altered, only the ring with the number of marks representing the speed of the flashes will be seen as a stationary ring; all other rings will appear as a blurr, thus making it very easy to calibrate the stroboscope.

Two sets of calibrations will be necessary, one for the low, and one for the high range.

This table is calculated from the denominator of the fraction,

$$\frac{3{,}000}{\text{flashing speed}}$$

when reduced to its lowest terms.

Thus, with a 3,000 r.p.m. motor to revolve the disc, when the lamp is flashing at 3,500, the number of dots appearing will be:

$$\frac{3{,}000}{3{,}500} = \frac{6}{7} = 7 \text{ dots}$$

This will hold true for flashing speeds over 3,000. For speeds lower than 3,000, the number of dots will still be obtained from the above fraction, but in this case it will be an improper fraction.

r.p.m.	LOW SPEED RANGE: No. of dots	LOW SPEED RANGE: r.p.m.	No. of dots
500	1	1,900	19
600	1	2,000	2
700	7	2,100	7
800	4	2,200	11
900	3	2,300	23
1,000	1	2,400	4
1,100	11	2,500	5
1,200	2	2,600	13
1,300	13	2,700	9
1,400	7	2,800	14
1,500	1	2,900	29
1,600	8	3,000	1
1,700	17	3,100	31
1,800	3	3,200	16
r.p.m.	**HIGH SPEED RANGE: No. of dots**	**HIGH SPEED RANGE: r.p.m.**	**No. of dots**
3,000	1	10,500	21
3,500	7	11,000	11
4,000	4	11,500	23
4,500	3	12,000	4
5,000	5	12,500	25
5,500	11	13,000	13
6,000	2	13,500	27
6,500	13	14,000	14
7,000	7	14,500	29
7,500	5	15,000	5
8,000	8	15,500	31
8,500	17	16,000	16
9,000	3	16,500	33
9,500	19	17,000	17
10,000	10	17,500	35
		18,000	6

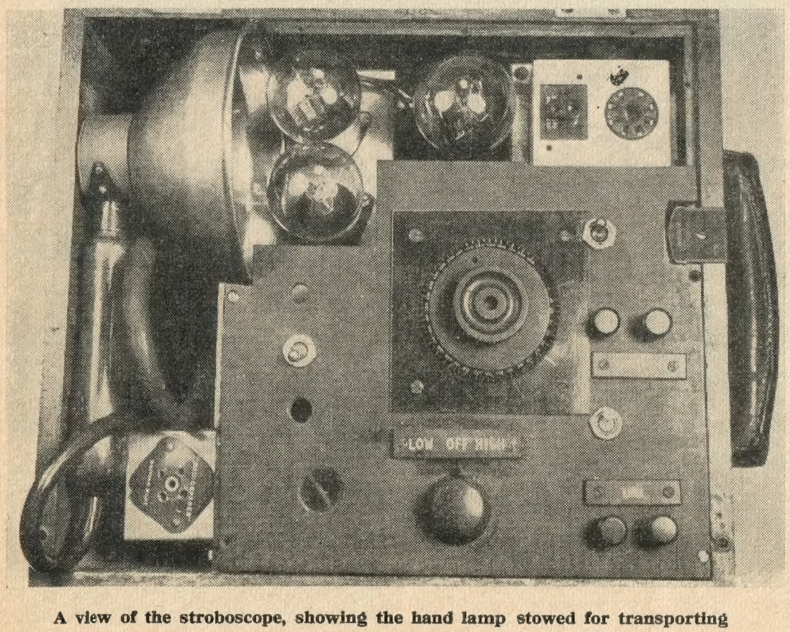
TABLE II

The Vibrator

This is an electromagnet and a vibrating reed, the coil of which is wound to work off the 4-volt tapping of the mains transformer, and will, on closing switch S.4, vibrate at mains frequency.

This is used to check the "strobe" against the mains, as there may be a slight variation in the 50 cycles at times, the dial is set to 3,000 and the lamp shone on to the reed, which should appear still. If not, a slight adjustment of R.2 or R.8 will put it right. The shafts of these are provided with screwdriver slots for this purpose.

Having made the calibrations, the stroboscope is ready for use, and a very useful instrument it should prove, amply repaying the time and trouble spent in its making.



A view of the stroboscope, showing the hand lamp stowed for transporting

CALLING ANGLESEY

Mr. J. Hughes Jones, Bryn Cian, Ty Croes, Anglesey, wonders if there are any other lone hands living on the island. He states that, although he cannot claim to have constructed any model yet, he has started on a $1\frac{1}{2}$-in. scale traction engine.

Mr. Jones also calls attention to the fact that, for the local agricultural show to be held on Saturday, August 6th, this year, the committee has decided to include a special section for models. Any reader in that district, who can enter a model for the show, should get in touch with the Secretary, Rhosneigr Agricultural and Horticultural Show, Cefn Dref Lodge, Rhosneigr, Anglesey, who will provide all necessary information.

Constructing a Reversing Switch

By "Duplex"

IN a recent issue of this journal, a correspondent asked where he could obtain a reversing switch for use with a 1/3 h.p., a.c., electric motor. Several switches of this type are available ready made, but there is no great difficulty in making a switch of this kind in the workshop. Some time ago, we made a switch for reversing a 230 V., d.c., ¼ h.p. motor that was used for driving a grinding head, and the correspondent, as well as other readers, may perhaps be interested in an account of the construction, as this type of switch is also applicable to split-phase, a.c. motors.

In the first place, care must be taken to ensure that there is no possibility of shorts arising in the switch mechanism itself, and also, in the interests of safety, all external parts must be effectively insulated to make the switch shock-proof.

Before starting on the construction, it is advisable to obtain a suitable insulating cover to enclose the switch mechanism, so that the components of the switch can be designed to fit into the space available. In this we were fortunate, because the transformer for the house bells had a plastic cover of just the right size, and we had no compunction in robbing it, as the transformer was safely hidden away in an inaccessable position at the top of a cupboard.

The switch is of the familiar rotating-drum type, and the drum is fitted with two shaped, brass sleeves that rub against spring contacts connected to the main leads, and to the motor windings; the actual connections for motors of various types will be shown later. The drum is made from a short length of ebonite or plastic rod having good insulating properties, and on it are pressed two contact pieces, cut to an L-shape from a length of brass tubing and secured in place with countersunk screws which enter for a short distance only.

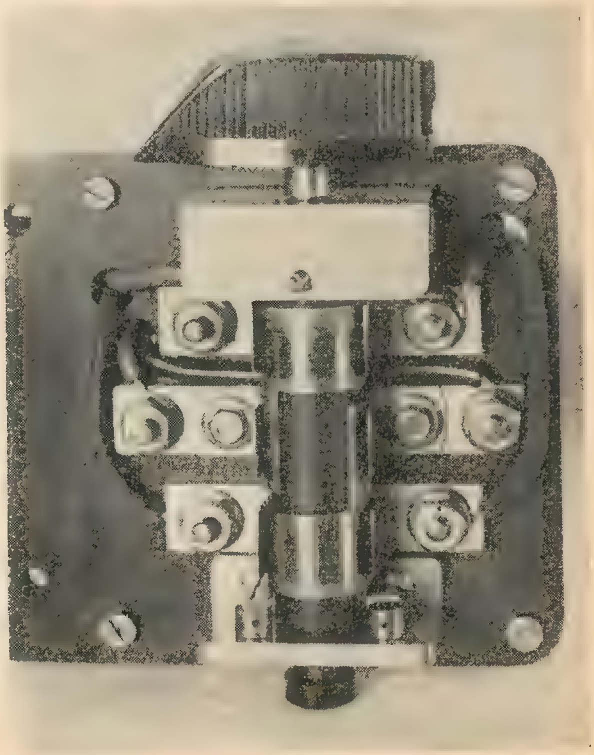
The drum is drilled axially at each end to carry the two pivot spindles, which are turned from mild-steel rod and then screwed in place or made a firm press-fit. The brackets that form the bearings for the spindle are made from brass angle-strip, or they can be fabricated. The bracket (2) at the upper end of the switch carries a stud to enable the cover to be held in place by means of an ebonite finger-nut. As shown in the drawing, the lower bearing bracket (3) is fitted with two screws with projecting heads; these engage the pin screwed into the ebonite drum and limit its rotation to a half-circle. At its upper end, the spindle of the drum is fitted with a fully-insulated finger-knob, secured with a buried grub-screw.

The wipe contacts, made from spring-brass strip, are of two types: those for the input and field connections are U-shaped, and the armature contacts are separate L-shaped fittings.

Each of the two field contacts is attached to a one-piece terminal bar, but the two armature contacts are fixed to separate, short bars.

The baseplate can be made from either ebonite sheet or any plastic material affording good insulation. The drawing shows the location of the drill holes for attaching the terminal bars and the terminals themselves; in addition, three holes are drilled to allow the wiring to enter and leave the switch box and, as can be seen in the photograph, four cheese-head screws are fitted to locate the cover. The baseplate illustrated was designed for mounting the switch

Fig. 1. The finished switch



Right: Fig. 2. The switch with the cover removed

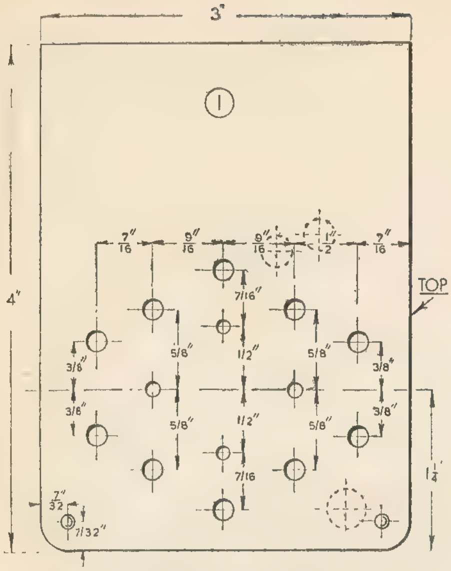


Fig. 4. The ebonite baseplate

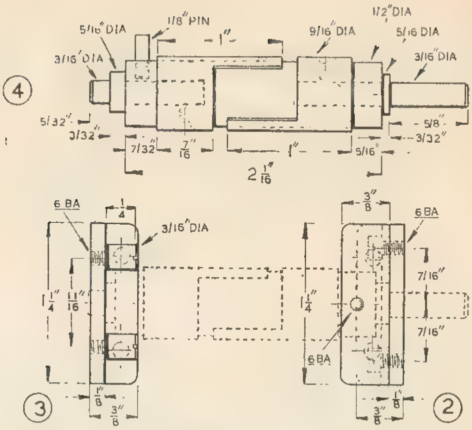
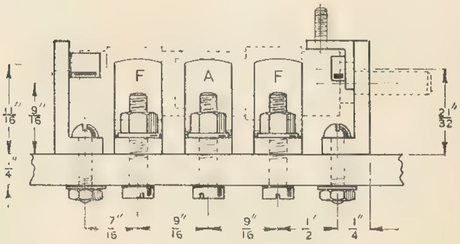


Fig. 5. The bearing brackets—2 and—3; the drum and contact segments—4



Right: Fig. 6. Showing the arrangements of the contactors and the drum bearings

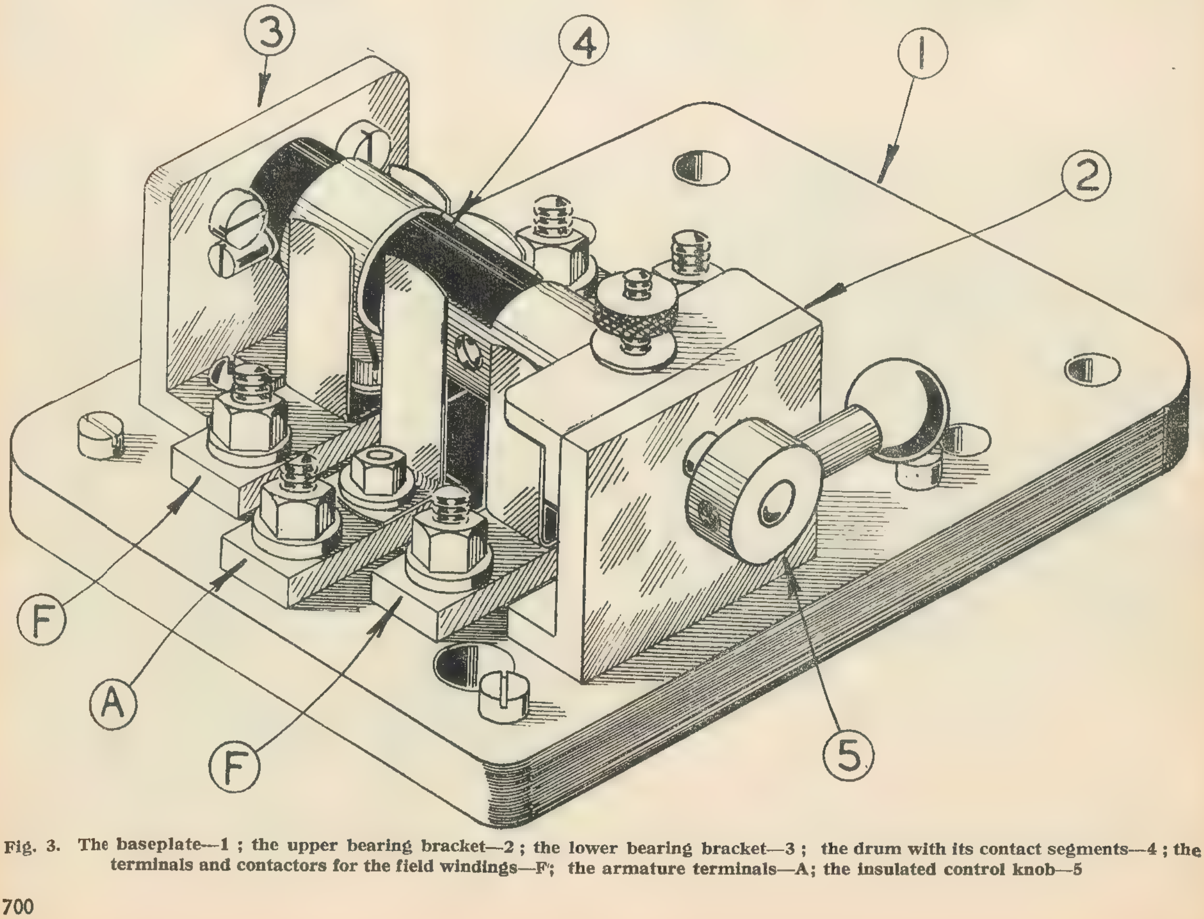


Fig. 3. The baseplate—1 ; the upper bearing bracket—2 ; the lower bearing bracket—3 ; the drum with its contact segments—4 ; the terminals and contactors for the field windings—F; the armature terminals—A; the insulated control knob—5

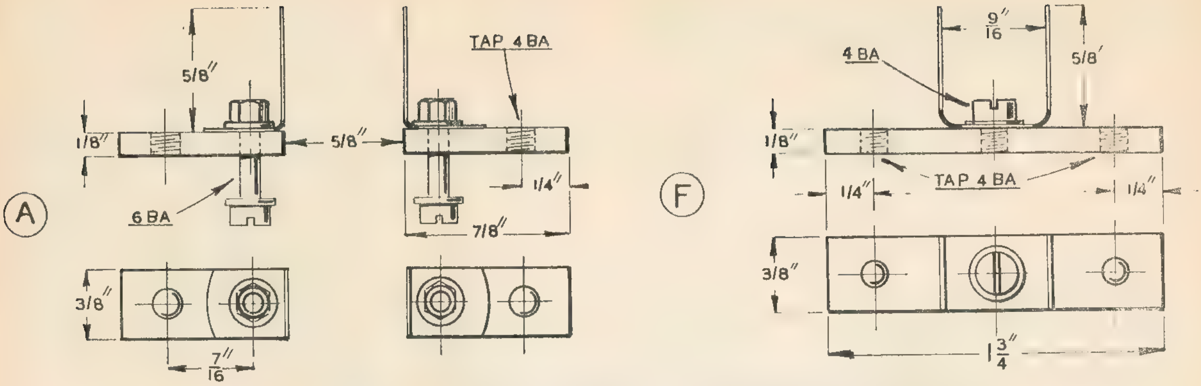


Fig. 7. The armature terminal bars and contactors—A; and those for the field windings—F

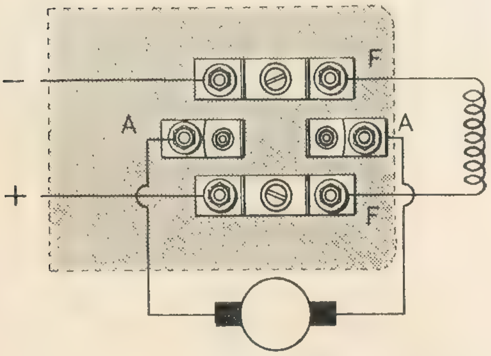


Fig. 8. The wiring connections for a shunt-wound motor

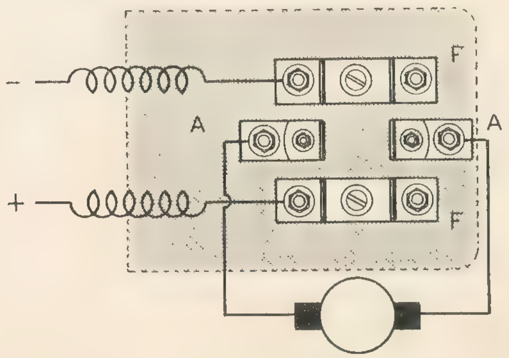


Fig. 9. The switch connections for a series-wound motor

on a panel; but, if the back is left exposed, a backplate must be fitted to cover all the live points and render the switch safe.

Assembling the Switch

The terminal bars can now be secured to the baseplate and the spring contacts fixed in place; the drum is then put in position and its bearings brackets are also screwed down to the baseplate. Before going further, make sure that all the spring contacts press firmly and evenly against the drum segments, so that the drum becomes rather stiff to turn. When the working position of the operating knob has been found, a flat is filed on the drum spindle to receive the tip of the buried grub-screw.

Finally, look the switch over carefully to make sure that all the components are spaced well apart, so that there is no possibility of an internal short occurring.

A shunt-wound, d.c. motor is connected in the way shown in Fig. 8; here, the armature leads are taken to the centre pair of terminals, and the field windings are connected to a pair of terminals on one side of the switch; the input leads are then taken to the two remaining terminals. In this way, rotating the drum of the switch will reverse the direction of the current in the field coils relative to that passing in the armature. As shown diagrammatically in Fig. 9, the armature of a series-wound machine is also connected to the centre pair of terminals, but the field windings are now connected in series with the input leads, and reversal of the direction of the armature current takes place when the switch is turned. An a.c. split-phase motor is reversed in the same way by connecting the starting coil to the terminals marked *A* and taking the ends of the running windings to the terminals *F*, so that the connections between the two sets of windings are reversed when the switch is turned. To avoid confusion, only the current-carrying leads are shown in the accompanying diagrams; but, in addition, for the sake of safety, an efficient earthing wire should be connected to the motor. When reversing an electric motor with this type of switch, which has a slow make-and-break action, it is essential first to stop the motor by opening the ordinary control switch, and then to turn the reversing switch before again switching on the motor.

A capacitor-start, a.c. motor can be reversed by means of a single-pole two-way switch, which reverses the connection between the capacitor and the starting and running windings, so that a drum switch of the double-pole two-way type is not needed.

Next Week . . .

INDEX FOR VOL 112

In this, the concluding issue of the volume, a detailed reference index of all subjects dealt with in the last six months will be included.

MODEL AGRICULTURAL TRACTORS

An interesting description of the construction of two scale working models, based on the "Field Marshall" tractor, differing in certain details, but both capable of useful work.

PETROL ENGINES

The carburettor and contact-breaker details for the general-purpose 10 c.c. four-stroke.

"NETTA"

We now come to the safety-valves for the larger sizes of this popular quintet of engines.

THE S.S. "ROBERT ALLEN"

The interesting series on the design and construction of this fine radio-controlled model is concluded. There is also a photograph and description of the method used in transporting this large model by means of a car.

An all-fabricated Lathe Headstock

By John Denver

I HAVE specified phosphor-bronze bearings in this headstock, because these can be produced satisfactorily, and they will give you many years of service before they will need renewing. The detail drawings in Fig. 4 show the two tapered bearings—a brief description will suffice for these comparatively simple parts. Make these two items first, and then use them as a gauge when producing the bushes. The taper is 15 deg.—I will not guarantee this is exactly the same as that on the original Milnes modification, but it will nevertheless perform just as well. The taper is all-important, so the reader must exercise all his skill in an endeavour to turn the diameter smooth, using the top-slide feedscrew as a means of traversing the tool. If you possess a Myford taper-turning attachment, then, of course, use this to secure the desired degree of finish.

Before disturbing the setting, turn up a cast-iron or copper lap, as this is needed for finishing the bush hole, and is preferable to using the actual bearing member for that work. Incidentally, you will note I am writing in the singular when describing these parts, as I wish to avoid confusion, but the same lap will suit both bushes.

When the male members have been turned to your satisfaction, start work on the bushes—boring and lapping them prior to finish, turning the outside diameters where they fit into the headstock body. Never trust the accuracy of your chuck for work-pieces demanding such accuracy, but finish the bore and turn the fitting diameter from a perfectly true-running spigot. Chamfer the leading edge slightly, as I have indicated, and do not make the diameter too large, otherwise you will experience great difficulty in driving the bush home. An interference of 0.001 in. is enough —in fact, if the bush is a tight push fit for the first $1\frac{1}{4}$ in. and requires a few light taps with a lead hammer, this is satisfactory. Alternatively, you can draw the bush into the housing if you take care, but I have never yet found this necessary.

Now let us revert for a few moments to the lapping question, as this obviously is an important factor. The brief sketch, Fig. 5, portrays a lap suitable for this operation, and I suggest you turn the taper between centres and use the tailstock member to guide it when applying the coned portion to the taper. Use the finest lapping material you can obtain and set about the process in what I shall describe as a gentle manner. Load the lap and press it very carefully with the rear centre while the lathe rotates at the slowest backgear speed. Release the pressure and examine the surface—it may take several applications before any appreciable difference is seen, but gradually the complete taper will assume a higher degree of polish as the high points are smoothed off. When you have judged the surface is ready for a trial with the gauge, release the bush from the three-jaw chuck and thoroughly wash it in petrol. Remember, you must remove all traces of grit both while trying the gauge, and certainly when the bearing is assembled. Some readers may question the lapping of a bronze bearing, but if care is exercised, and the pressure applied very lightly, then the taper should not become impregnated with the grit. If you always keep in mind the fact that work of this type is producing the finished product and requires a fair amount of skill, then the surface so made is of a high order.

Checking with the gauge, in other words the finished bearing, means the latter is smeared with blue before you can offer it to the bush. Remember only a light smear is needed, and when the bearing is given two or three twists, this material is transferred to the bush and will denote the high spots which still need removing. When the blue marks appear over practically all the

Continued from page 691, *June* 16, 1955.

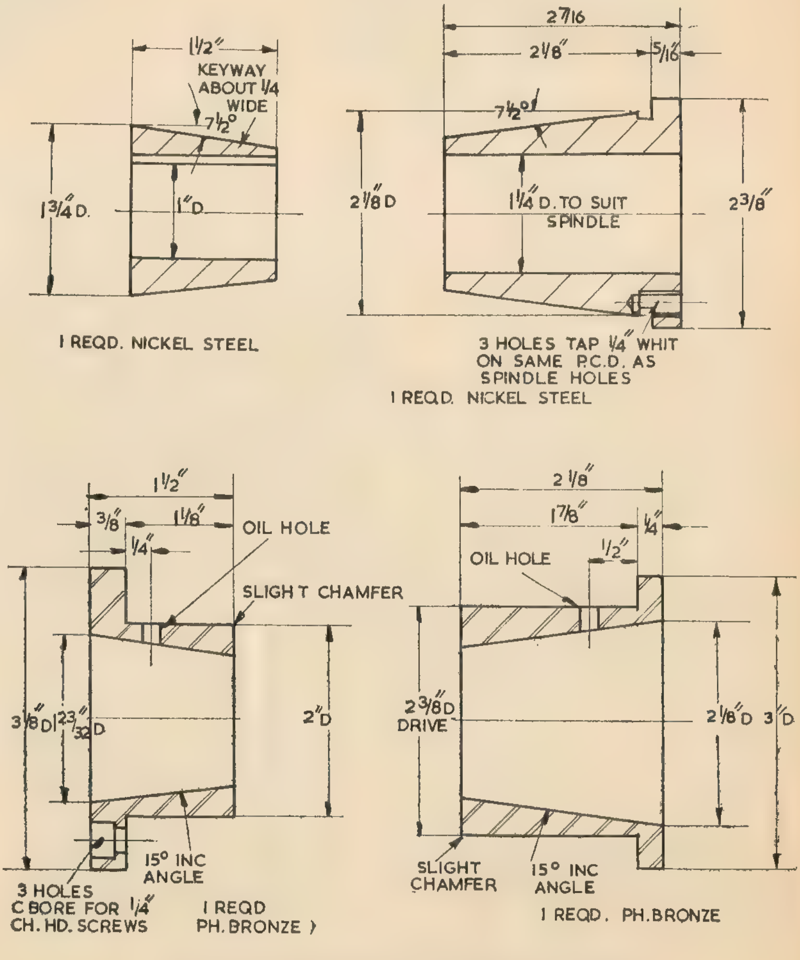


Fig. 4. Detailed drawings of the tapered bearings

cone, the two parts match correctly and are ready for their task in the machine.

Drilling and counterboring the front detail is a simple operation, but I advise readers to omit to use the plug tap when screwing the holes if possible, to ensure that the screws are a tight fit. Thus vibration, which is bound to occur in such operations as parting-off or deep forming, will not tend to shake the screws loose. Alternatively, if this idea is not successful, insert screws which you have specially selected with the aid of your micrometer and found well up to size on the outside diameter.

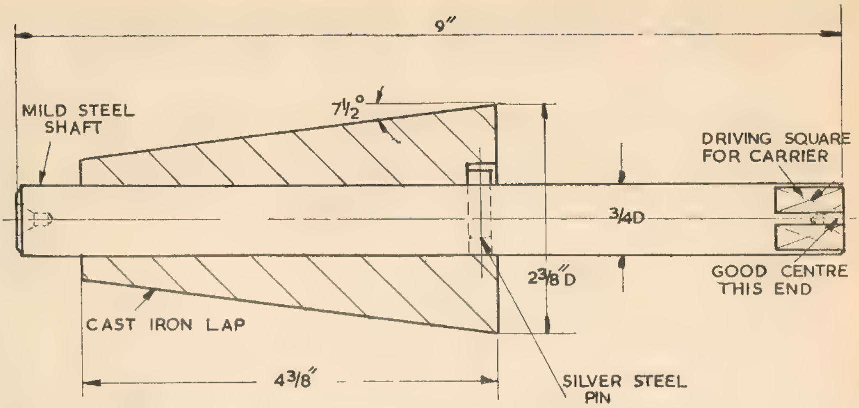


Fig. 5. Detailed drawing of the lap used for the bearings

The Spindle

A piece of nickel-steel is the best material for this spindle, but I doubt whether many of you are in the happy position to select the proper steel that you require. Mild-steel is useless for the task—at least I think so, though many will have no alternative but to use it, so look around in your local car-breakers yard for an old lorry rear axle of sufficient size to enable it to clean up to the appropriate dimensions. These are made of special alloy-steel, and are ideal for the work they will now have to perform. An annealing process is undoubtedly necessary before any machining is possible, but this is not a formidable task and an hour in the domestic boiler fire, followed by a very slow cooling, will make it soft enough for you to cut it without ruining all your tools.

Completely rough turn the shaft before attempting to finish any diameters; drill the hole through the centre and cone the end for the Morse taper centre. The hole may cause you some difficulty, but there is no need, if reasonable care is taken, to drill it through from one direction. Start the drill carefully, and make sure it does not wobble when first offered to the shaft—then proceed to feed it slowly through the spindle. Frequent withdrawal is essential to clear away the chips, and when the halfway stage is reached, the shaft is reversed in the chuck, set to run truly and then the drill is started from that end. It will meet with little or no " step " in the middle; whereupon you can now reset it truly and machine the Morse taper—first by boring with the top-slide set over slightly, and then with a reamer. The latter you can make from silver-or cast-steel hardened and tempered.

When this bore is finished, turn up a plug and use this as a location while the outside is finished turned—the tailstock centre again supporting the opposite end ; a carrier attached to the shaft will provide the necessary drive when this operation is undertaken.

Pulley Details

Detailed drawings of these parts will not convey much to the reader, because he already knows exactly how they appear from the arrangement drawing given in the previous instalment, and the lengths and diameters will vary considerably from those shown there.

The front spindle diameter is 1¼ in., reduced to 1⅛ in. where the pulley rotates. Finally, it again steps down to 1 in. where the rear bearing applies and the thrust-race is assembled. This latter part, incidentally, is a Ransome and Marles light type LT.1, with a bore of 1 in., an outside diameter of 1 25/32 in., and a width of ⅝ in.—a convenient thrust-race for the work it must perform.

A washer is introduced between the shoulder of the main shaft and the thrust-race, and this is made from a piece of case-hardening mild-steel suitably heat-treated, and ground if possible on the thickness, to make this perfectly parallel; it need not fit too closely on the spindle and a drilled hole 1 1/64 in. larger is satisfactory.

The assembly of this spindle and bearings in the headstock needs no explanation, but the final adjustment for the free movement of the spindle obviously requires careful attention. It should rotate easily without any trace of end slackness—in fact a sharp twist should cause it to make two or three turns. Taper bearings are a little more difficult to adjust exactly, but patience is the deciding factor, and ten minutes should see the spindle properly set in the bearings.

So far I have omitted to mention oil holes, but this is a matter in which you can again please yourself, and this also applies to the design of oil cups. I must confess to having a liking for the massive glass container—the type where the flow is controlled from a mere occasional drip to a steady flow. However, the advantage with these is the visibility of the oil, and I believe that bearings with this class of oiling arrangement receive more attention than the small cups with a snap cap. You can fit them where you wish, but I think behind the overhead arm is a good place—it tends to protect the glass container, and hides the " unsightliness " which some readers contend is a disadvantage with this method of oiling.

Little now remains for discussion. The assembly on the lathe bed is a matter of routine, and a try-out will reveal whether the axis is aligned correctly. A dial indicator is a useful accessory, coupled with a flat surface-plate and angle-plate for this work, but as few possess this equipment, there is no point in my describing how to set the spindle in this manner. If the location while boring the bush holes is taken from either the edge mentioned earlier, or the strip fixed underneath to locate the headstock to the bed, then on assembly it should align correctly.

The male taper members may prove an awkward problem to those who cannot induce their top-slide to turn smoothly—I am assuming, of course, in this case a turning attachment is not available, and you must necessarily rotate the handle slowly without producing deep lines in the surface. Rotary grinding is the best way to finish them, preferably on that type of machine and not on the lathe, but unfortunately few have access to such plant. There are many turners who will advocate filing the taper smooth, but my advice is, never attempt it. Only a very few can perform this operation properly—I admit I am not in that category, and there is a general tendency to impart a wavy-cum-series-of-flats finish. If a very minute cut of say, 0.005 in. is taken very slowly, the resulting finish is perhaps the best you can achieve in this manner—an external lapping process will help, but only if the grooves left in the shaft are in the region of 0.0005 in. Incidentally, while turning the lap, the same setting is maintained for the bearings—this is so obvious I almost refrain from mentioning it.

Guards over the gears are a necessity, and these, if cut from 0.03 in. thick

(*Continued on page* 721)

ROTARY PUMPS AND MOTORS

A PRACTICAL REVIEW OF THEIR DESIGN AND CONSTRUCTION — TYPICAL EXAMPLES OF CENTRIFUGAL PUMPS

By "Artificer"

THE high-lift pump by Messrs. Mather & Platt Ltd., of Manchester, shown in Fig. 10, may be taken as generally typical of the design and construction of multi-stage pumps. It will be seen that each stage, comprising an impeller, casing and diffuser ring, is essentially identical and forms a constructional unit, so that it is possible to build up pumps with different numbers of stages, according to the output pressure required. The inlet to the pump is on the right, and the discharge by way of the vertical passage in the left-hand endplate. Shrouded impellers, with sealing rings at the entry are employed, as this is most convenient for manufacture, especially in view of the unit construction, but this arrangement results in setting up considerable end thrust, and to compensate this, an ingenious hydraulic balancing device, utilising the delivery pressure of the water, is fitted at the discharge end.

The main bearings of the impeller shaft are spaced well away from the pump casing, where they are readily accessible and protected from ingress of water; they are of adequate area and lubricated by ring-oilers. Pumps of this type have a very high mechanical efficiency, up to more than 75 per cent., and run for years with the minimum attention.

Continued from page 646, June 9, 1955.

Varley Deep Well Turbine Pumps

In view of the limitations of atmospheric pressure, which prevent any type of pump from operating at a greater suction lift than about 30 ft. at the very utmost, it is necessary when drawing water from deep shafts to locate the pump as close to the actual water level as possible, and for this purpose centrifugal pumps are well suited, as they can be lowered bodily into the well and driven by vertical shafts of practically any length. The "Peerless" pumps made by the Varley Pumps and Engineering Co. Ltd., Brentford, Middlesex, are representative of the type of pump used for such purposes; like the previous example, they are of unit construction and can be built in various numbers of stages, to cover quantities up to 30,000 gallons per hour, from wells 1,000 ft. or more in depth. The inlet and discharge passages are coaxial with the driving shaft, with a suction strainer of large area at the bottom, and discharge by way of the annular casing around the shaft, after the water has passed through each pump unit, with its impeller and diffuser, in turn.

In addition to direct-coupling to a vertical-shaft motor, these pumps are also made with other forms of drive, including flat and multiple-vee belts, or by bevel gearing from a horizontal shaft. The arrangement of the pump is illustrated by the $\frac{1}{8}$ scale working model seen in Fig. 11, which was made by the apprentices at the Varley works, and presented to the managing director last Christmas. This is an excellent example of the way in which model engineering can be made to serve a double purpose, as a useful and interesting training exercise, and a practical means of demonstrating the final product.

Hamworthy Vertical-spindle Pumps

The Hamworthy Engineering Co. Ltd., Poole, Dorset, manufacture several different types of rotary pumps, including the vertical centrifugal pumps, Series VB and VC, designed primarily for use as marine auxiliaries, with outputs up to over 1,000 tons per hour, or 4,000 gallons per minute, at total heads (combined suction and pressure) not exceeding 230 ft. These are of the single-stage type, with a hydraulically-balanced gunmetal impeller on a stainless steel shaft, direct-driven from a motor mounted above the pump frame. (Fig. 12).

The weight of the impeller assembly is carried by the motor bearings in the smaller sizes, but in larger pumps, a dual-purpose ball race is fitted in a sealed housing above the pump, to take both thrust and radial loads. A packed gland is fitted to the upper end of the pump spindle and a white-metal or gunmetal bearing to the lower end,

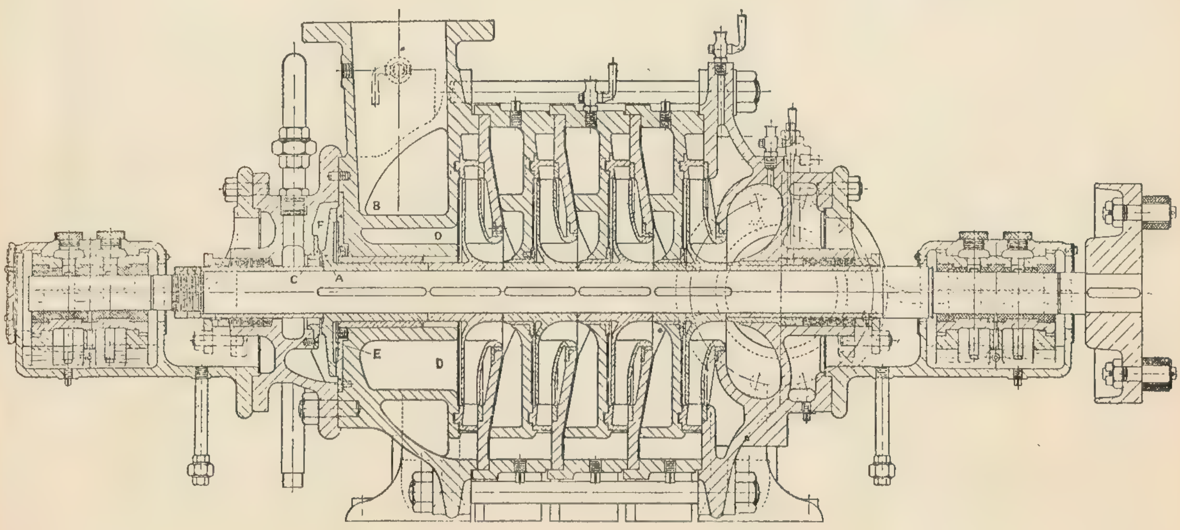


Fig. 10. Mather & Platt four-stage high-lift turbine pump

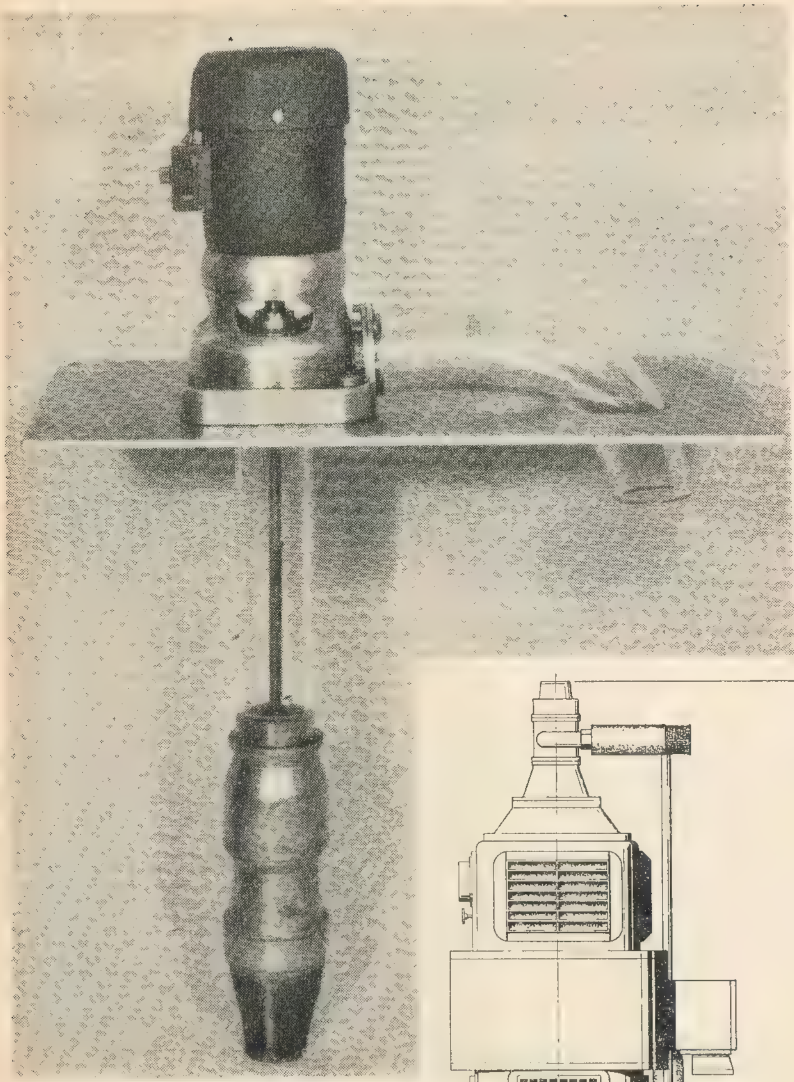


Fig. 11. A $\frac{1}{8}$-scale working model of the Varley " Peerless " deep-well pump

lubrication in both cases being by screw-down grease cups. The impeller is of the shrouded type, with sealing rings both above and below, and entry is from the upper side of the casing, by way of a large capacity water chamber which enables air to be trapped and separated from the incoming water. Discharge is by the usual expanding volute at the periphery of the chamber, and by way of a tangential outlet to a rising main or other delivery system.

A specially interesting feature of these pumps is the automatic self-priming device which is fitted where it is not possible to instal the pump below the water line so as to keep the pump casing flooded. This device comprises a dry rotary exhauster of the sliding vane type, mounted on the top of the motor and working in conjunction with suitable control mechanism, to produce a depression in the pump casing when starting from a dry state.

Two different methods of operating this control are applied; in the first, fitted to the smaller sizes of pumps, the drive to the exhauster is arranged to be engaged with the motor only when required, by friction gearing controlled by the pressure in the discharge volute of the pump. This is effected by means of a diaphragm having its underside connected to the volute. When there is no pressure in the latter the diaphragm is relaxed, and this allows the friction gearing to engage, thus driving the exhauster, and the resultant suction draws water into the impeller casing. As soon as pumping commences, the pressure exerted on the diaphragm causes it to distend, thereby disengaging the friction drive.

In the second system, employed on the larger sizes of pumps, the exhauster is in constant engagement with the driving motor, but is put in communication with the pump chamber, or with the atmosphere, by means of an automatic control actuated by means of a float fitted in the air separating chamber in the main pump frame. When the pump is empty,

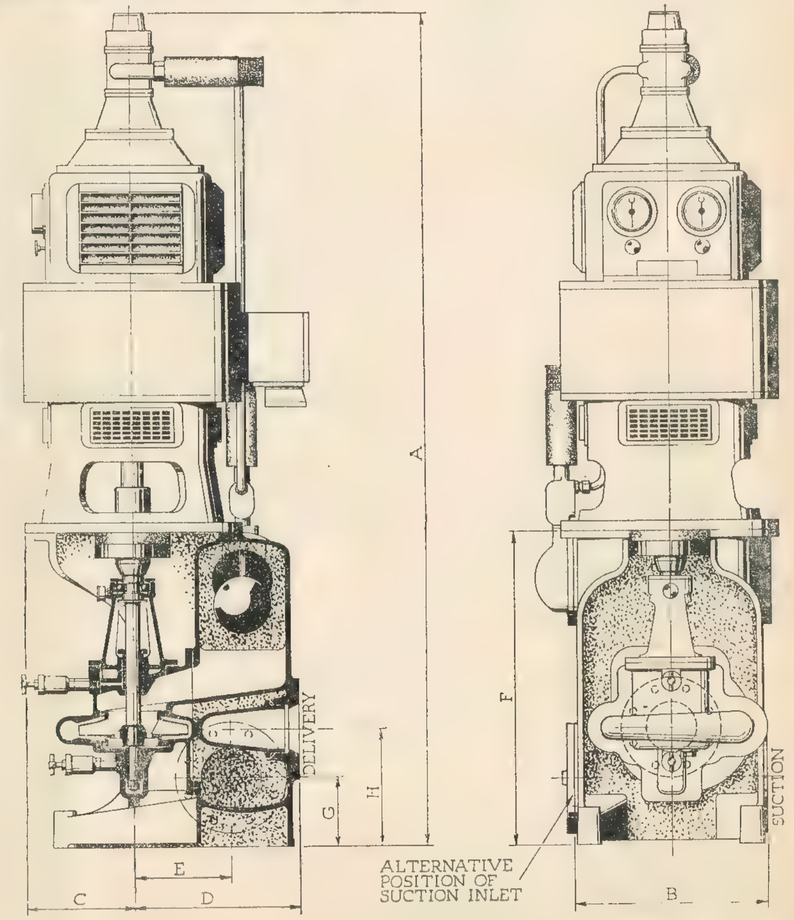


Fig. 12. The Hamworthy vertical single-stage pump, with float-controlled automatic priming system

the float is in its lowest position, and the exhauster is thereby connected to the suction side of the pump. Immediately, the pump is primed, the separating chamber fills with water, so that the float rises, changing over the exhauster connection to atmosphere, so that it is relieved of load. In this way it ensures that water can never reach the exhauster, but should air become entrained in water by momentary loss of suction or other causes, the lowering of water level in the separating chamber will bring the float control into action and keep the pump working at full efficiency. This feature makes the pump highly suitable for use as a bilge or ballast pump.

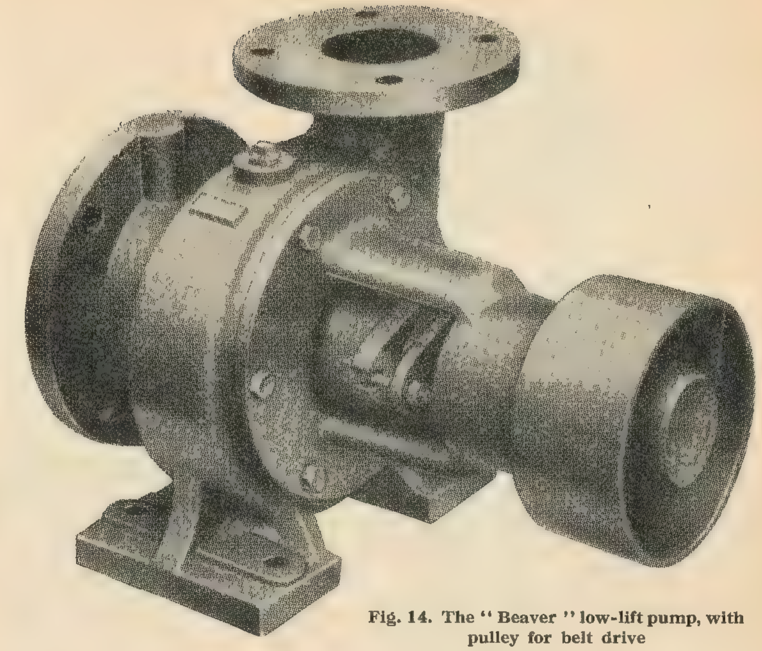


Fig. 14. The "Beaver" low-lift pump, with pulley for belt drive

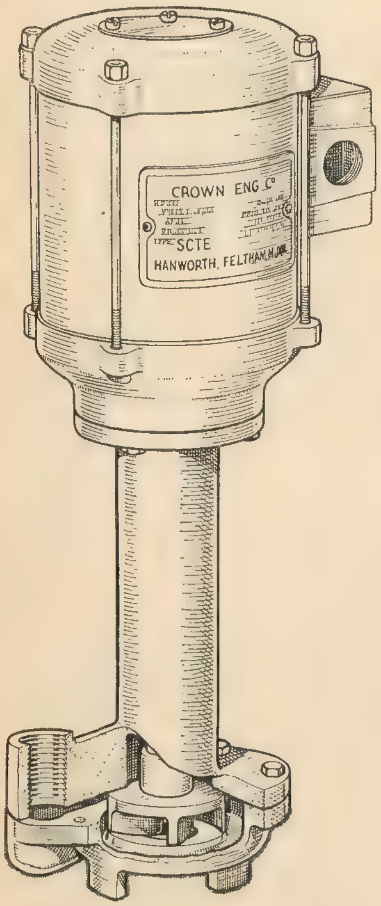


Fig. 13. The "Crown" vertical pump and motor unit

"Crown" Vertical-shaft Pumps

While on the subject of vertical-shaft pumps, it is worth while to observe that this arrangement is equally well suited to small pumps as to large ones, and there are many examples of pumps for industrial and other purposes, such as sump drainage, and the supply of coolant to machine tools, where the convenience of the vertical self-contained pump and driving motor is an important asset.

An example of this type of pump, made by the Crown Engineering Co. Ltd., Hanworth, Middlesex, is illustrated in Fig. 13. This is a compact unit, having an overall height of 14½ in. and a width of 6 in., with a weight of 16 lb., but it has a capacity of 360 gallons per hour. The impeller, which is cast in aluminium, is of the shrouded type, and the entry passage in the bottom of the casing is well suited to the fitting of a large circular filter screen. A vertical discharge port is provided, with an internal thread to take ½ in. B.S.P. delivery pipe.

"Beaver" Pumps

Messrs. John Cherry & Sons, Beverley, Yorkshire, specialise in the manufacture of single-stage centrifugal pumps, mostly for operating on relatively low heads, and in a range of sizes from ¾-in. to 10-in. delivery passage, with outputs from 150 to 150,000 gallons per hour. The "Beaver" LL type, illustrated in Fig. 14, covers the most popular range of sizes, and will operate on a total head up to 50 ft., including maximum suction lift of 25 ft., at a speed of 1,400-1,500 r.p.m.; provision is made for either direct coupling or belt drive. Ball bearings, with grease lubrication, are fitted in an outrigger housing to support the shaft and take either end-wise or radial load, and a packed gland with renewable neck bush is provided.

Goodenough Portable Pumps

A range of pumping sets, driven by petrol, paraffin or diesel engines, is manufactured by Goodenough Contractor's Machinery Ltd., Twickenham, Middlesex, and these incorporate single-

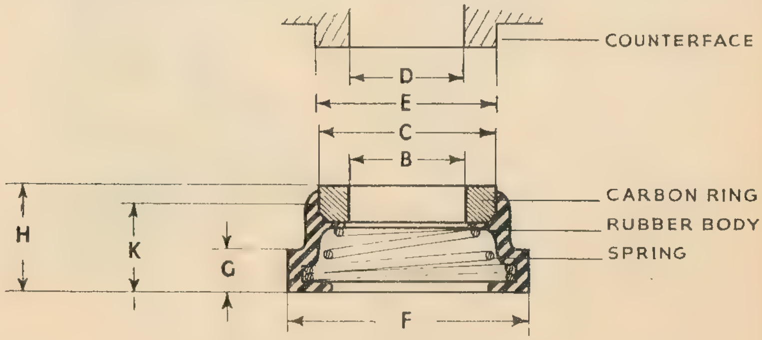


Fig. 16. The Morganite unit seal

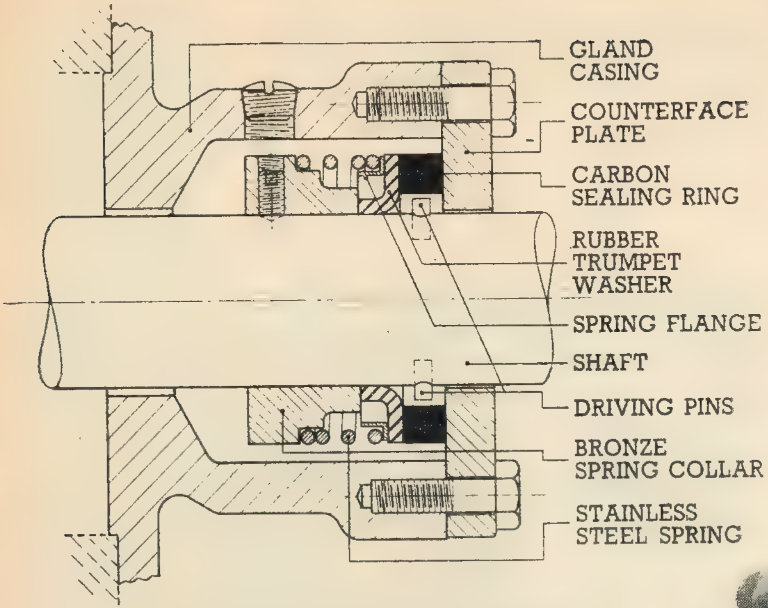


Fig. 17. The Morgan-Stuart gland assembly

It is evident therefore that a gland or glands must be fitted to the shaft where it enters the casing; this applies to some extent to most forms of rotary pumps, but is of special importance in the centrifugal type. The normal form of packed gland, with a screwed ring or bolted flange, and filled with soft cotton packing impregnated with tallow or graphite grease, is quite satisfactory in most cases, provided that it is well designed and sufficiently deep to enable resilience of the packing to be maintained. Other forms of glands, however, employing special moulded packings or hydraulic cup leathers, may be employed, and in some cases water-packed labyrinth glands are used to reduce or relieve pressure on ordinary packings.

In recent years, the "packless" gland has been extensively employed for rotary seals of all kinds; its usual form

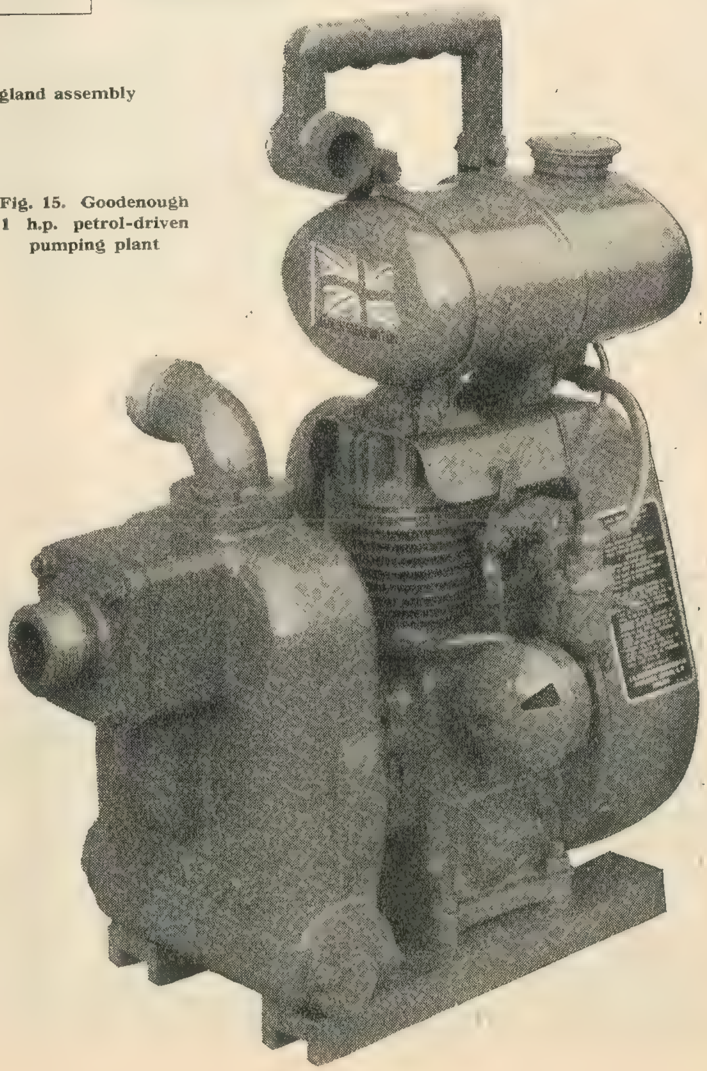
(*Continued on page* 710)

stage centrifugal pumps of unusual design. As these sets are used "on location" and have to be brought into action with minimum delay, it is not usually possible to submerge the inlet, and it would be very inconvenient to have to prime them each time they are started up. They are therefore arranged to be self-priming, by the provision of a large water reserve chamber in the pump casing. Once filled, this contains sufficient water to ensure that the pump is adequately primed, and will start up consistently with a guaranteed suction lift of 25 ft. These pumps are made with a delivery bore from 1½ in. dia. to 4 in., with outputs from 1,500 to over 30,000 gallons per hour. The smallest in the range, illustrated in Fig. 15, is driven by a J.A.P. 1 h.p. petrol engine, and will handle 4,000 gallons per hour at 5 ft. suction lift; maximum total head, 70 ft.

Shaft Glands

An important factor in the success of a centrifugal pump is the avoidance of leakage to or from the casing. The point at which the shaft enters may be either under a positive or negative pressure to the outside atmosphere; in the former case, seepage of water may be troublesome, or even actually dangerous if it reaches the electrical parts of the driving motor; in the latter, entry of air may impair suction lift or cause erratic working. Generally speaking, single-entry pumps usually have a somewhat higher pressure at the region of the shaft, and double-entry pumps, a partial vacuum at this point. In either case, a submerged pump when left standing will be liable to an escape of water.

Fig. 15. Goodenough 1 h.p. petrol-driven pumping plant



A PORTABLE COMPRESSOR SET

By Niall MacNeill

THE photographs illustrate one example of the simpler applications of ex W.D. stuff suggested by "Artificer's" series of articles entitled "Swords into Ploughshares" which ran in a number of issues of THE MODEL ENGINEER from November 6th, 1947.

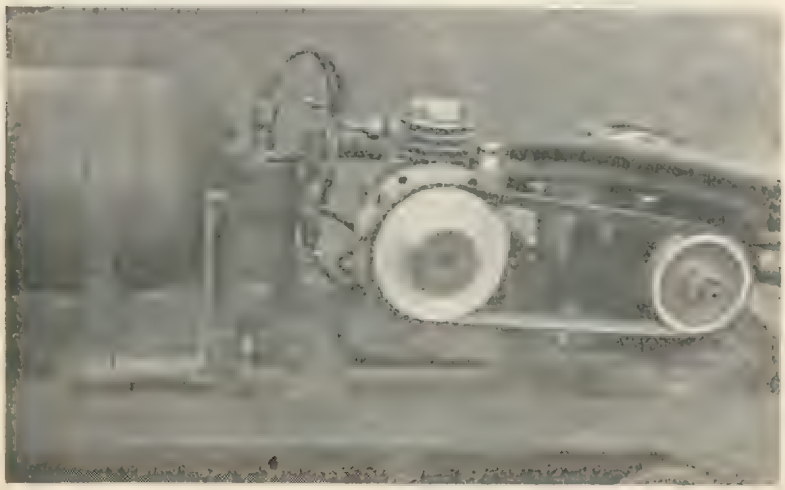
The general arrangement involved is by no means novel, but the particular application may be of interest.

An ex R.A.F. BTH compressor, type AVAM, an ex Air Ministry steel "bottle" and a pressure gauge reading to 150 lb./sq. in. were bought from advertisers in this journal. A $\frac{1}{2}$-h.p. split phase electric motor, ex American woodworking machine, was purchased secondhand. Four rubber-tyred "toy" wheels, a 28-in. rubber vee belt and a length of air hose were bought new. The whole lot cost less than £10 10s. The rest of the materials were provided by the workshop accumulation of odds and ends.

A general view of the compressor set

The wooden body of the trolley is 1 ft. wide × 2 ft. 9 in. long × $1\frac{3}{8}$ in. thick. A 2 ft. 6 in. length would have sufficed, in which case a 24 in. vee belt would be used, but as I happened to have the 2 ft. 9 in. platform, made up from two pieces of board for some other purpose, I used it as it stood.

The axle and steering arrangements need no further description than is given by the underneath view, except to say that steel pins, located closely fore and aft of the bolt by which the handle is pivoted in the steering frame, limit that handle's fore and aft tilts to 55 deg. and 15 deg. from vertical respectively. This arrangement prevents the handle fouling the air bottle when in the backward position, and holds it within easy reach, well clear of the floor when tilted forward.



Side view, showing air cleaner

The disposal of the various components on the trolley calls for only one remark. It will be observed that there is an idle space on the "starboard side" opposite the compressor. The original idea was to fit a second of these little compressors and drive it from the now idle end of the double-ended motor shaft.

In use at a Dublin S.M.E.E. Exhibition, driving models by compressed air, the motor tended to overheat very much. It is rated only 40 per cent. continuous. The project of having twin compressors was therefore deferred, with the idea that a motor of 100 per cent. continuous rating and perhaps 1/3rd or $\frac{1}{2}$ h.p. would be substituted, but as it serves my workshop needs well enough as it stands, this project never materialised.

In this connection readers may be referred to a letter by F. Shipley in THE MODEL ENGINEER, Vol. 99, No. 2458, p. 25 (July 1st, 1948) on modification to reduce power required to drive compressors of this type.

For general maintenance data, a letter by R. H. Tyler in Vol. 98, No. 2448, p. 441 (April 22nd, 1948) may also be referred to. The latter gives the useful

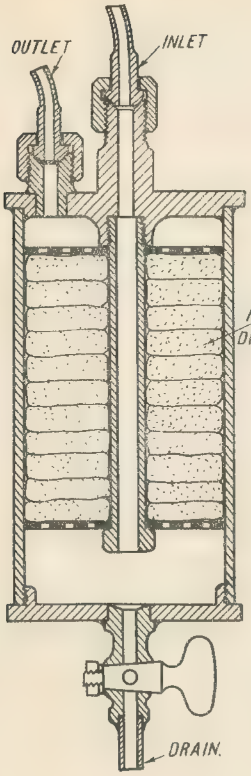


Fig. 1

piece of information that castor oil is a suitable compressor lubricant.

Where pressure is concerned, these compressors are masterly performers, but the opposite is true with regard to the volume of air delivered—only 0.4 cu. ft. per min., according to the last-quoted authority.

The flex for connection to mains is joined to the motor through a porcelain cartridge fuse-holder. Motor r.p.m. is 1,425, and using a 3 in. pulley on its shaft, with a 4 in. pulley on compressor, gives a compressor speed of slightly over 1,000 r.p.m. which appears to be quite satisfactory. Provision for adjusting belt tension exists in the slotted holes in motor base.

The Mount

The compressor mount is a right-angled piece of $\frac{1}{4}$ in. thick aluminium, sawn from scrap, and radiused at its upper edge to match the shape of compressor crankcase, to the flange of which it is fixed by two short $\frac{1}{4}$-in. bolts through existing holes in the flange. The bolting-down holes in the base of this mounting are also slotted, but in right-angled respect to those in the motor base, to allow of adjusting alignment of motor and compressor pulleys.

As originally used, without the air cleaner, a lot of oil and probably also condensate water passed into the air receiver and delivery line. An air-cleaner trap—the small cylindrical affair shown in the photographs—was, therefore, made up entirely from brass scrap.

Since the photographs cannot reveal its interior, the illustrations include a section drawing of this item (Fig. 1) which I hope will be largely self-explanatory. Neither the particular design nor its dimensions are important, and it is described only to suggest general lines upon which such an accessory might be made. A size, roughly about that of a $\frac{1}{2}$-lb. cocoa tin, as in the original, will be suitable.

With the exception that the outlet union—assuming my general plan is followed—had best be a separate piece, turned and screwcut first and afterwards brazed into a suitable hole, the top plate may be all one piece. Alternatively, it may be entirely built up from flat and round pieces of brass. Its assembly to the cylindrical body will most suitably be by brazing (Easyflo silver-soldering I used).

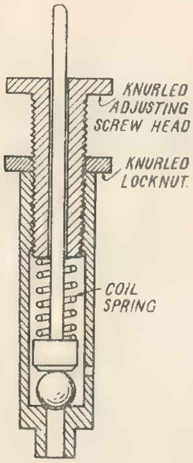


Fig. 2

The cylinder should be of heavy gauge stuff, both to withstand pressure, and to have body enough for screw-cutting to receive the bottom plate. My scrap box provided a piece of brass tube, about $2\frac{1}{4}$ in. outside diameter, and nearly $\frac{1}{8}$ in. wall thickness.

The internal extension of the air inlet pipe not only ensures that the incoming air is first conducted to the bottom of the cleaner, but serves as a support for a pile of discs of carpet felt, held between two metal plates, each having a number of holes drilled in it as air passages.

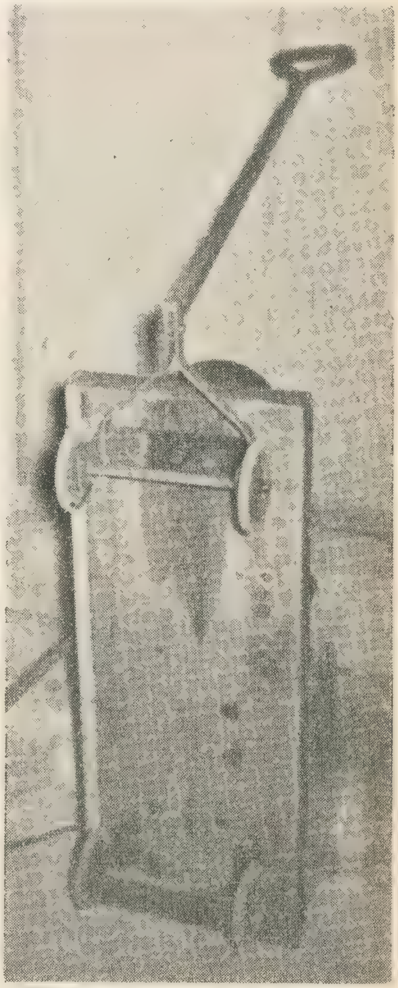
The felt discs should be snug fits in the cylinder bore, and on the central tube, so that the upward travelling air may have no freer passage than through the felt.

For convenience of assembly, the shoulder at the lower end of the tube which supports the pile is a hexagon—an old brass nut bored out and brazed to the tube. Matters should be so arranged that there is a clear space of from $\frac{1}{2}$ in. to 1 in. depth below the tube to serve as sump.

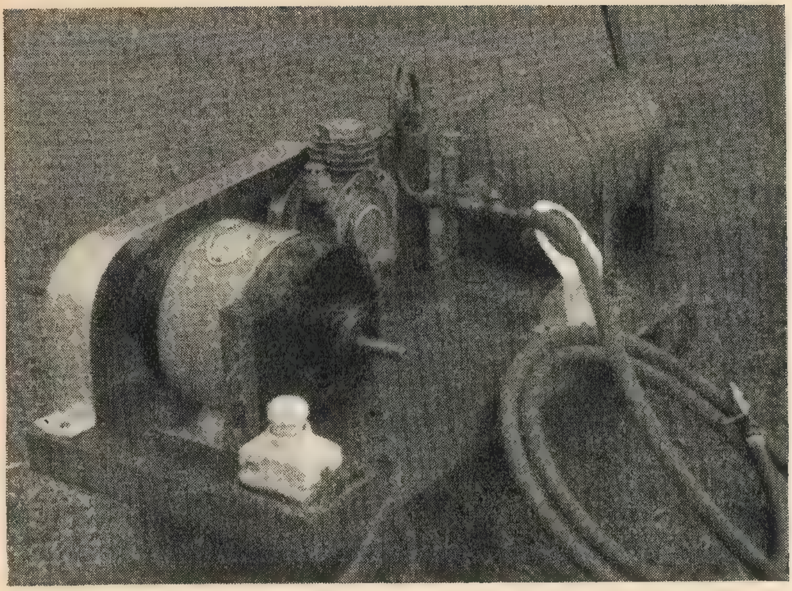
When planning the work, I thought that a leather or fibre washer might be needed between bottom plate and cylinder, but an application of redlead to the screw before assembly has given a perfectly airtight result.

An extension spout, consisting of a piece of brass tubing long enough to pass through a hole in the floor of the trolley, is silver-soldered to the bib cock.

That this trap does serve to clean the air, as well as do away with the need of over-exactitude in replenishing crank-case oil in the compressor, is shown by the appreciable quantities of an oily emulsion blow off when, from time to time, the cock is opened after running up a light pressure in the air receiver.



Up-ended view, showing "chassis" details



Three-quarter view, showing belt-guard in position

The 2-way connection stopper fitted to the air bottle was converted to 4-way working by cross-drilling. Into one of the additional orifices so provided, the body of the relief valve was directly silver-soldered. To the other, a piece of brass turned and screwcut to receive a gland nut, was similarly fixed. This serves as connection for pipe to pressure gauge.

The structure of the relief valve is also shown by a section drawing (Fig. 2), but I rather think that for this purpose a disc instead of a ball-valve would be preferable. The one in the "prototype," which I never got round to improving or replacing, can be adjusted to hold up to and blow off accurately enough at a given pressure, but tends to reclose only at considerably below that pressure, and to sizzle a bit even after that.

Under the Influence!

The rubber-tyred wheels, besides their more obvious purpose, serve to quieten the set when in use. Before they were fitted, it was very noisy, and would creep all over the shop under the influence of vibration.

The straps by which the air bottle is held down are lengths of steel baling strip, made rather short so that they can be nutted down quite tight. The bottle rests on two curved wooden bearers. Bands of this baling strip were also used for fixing the air cleaner to its support, the latter simply a piece of bar iron bent into a right-angle and suitably drilled.

The guard for the motor-compressor drive is a piece of 18-s.w.g. sheet aluminium, fixed to the floor by round-headed wood screws at each end. It just occurs to me that a fixing by wing nuts to small—say $\frac{3}{16}$ in.—bolts (square under head and tight fit in holes in the trolley floor) would be a much better job for a part like this, which should be easy to detach and replace.

This compressor set has given very satisfactory service, mainly in use with a $\frac{3}{8}$-in. gas blow torch. It has also had considerable use by a friend in light spray-painting work, and with an air brush.

A Substitute

While I was doing the silver-soldering obs involved in its construction, I had need for a substitute for itself. This led me to discover a method which will prove very simple and effective where a low-pressure air supply is required, and foot-power the only means of providing it. I fitted a second Schrader valve body to an old motor tube and used it as air receiver or smoother, in conjunction with a motor foot pump. A valve core is used only in the valve to which the foot pump is connected, the other simply serving as delivery nozzle.

I was agreeably surprised at how well this simple device worked; far better than the conventional foot bellows as used by dental mechanics. The only precaution needed is against pumping too hard while one's attention is absorbed by the brazing or other work, and even that precaution would not need nearly so close attention if the tube were accommodated in an old tyre cover—preferably an oversize, in order to derive full benefit from the tube's elasticity.

ROTARY PUMPS AND MOTORS

(*Continued from page* 707)

comprises a rubbing contact member of hard steel, bronze or carbon, precision faced to work with minimum friction on an equally accurate stationary face, and kept in close contact with it by means of a spring enclosed in a metallic bellows, sometimes incorporating a pressure-compensating device. These glands, if well made, require no adjustment, and keep a perfect seal for very long periods, besides having a very high mechanical efficiency.

A very simple form of packless gland, known as the Morganite Unit Seal, has been developed by the Morgan Crucible Co. Ltd., Battersea, London, S.W., in which an anti-friction carbon ring is bonded to a rubber bellows, with an enclosed spring which keeps the ring pressed against the face of the impeller hub of the pump, or other flat-faced collar (Fig. 16). The rubber member is a friction fit in the pump housing, preventing rotation and also sealing the shaft aperture. This arrangement can be reversed, so that the rubber member fits a recess in the back of the impeller, and the carbon ring presses against a recessed face in the casing; either method is equally efficacious, and as the spring pressure required to maintain the seal is extremely small, it can be used in small pumps driven by motors of low power.

An adaptation of the same principle, known as the Morgan-Stuart gland assembly, can be fitted to an existing gland housing; in this case the carbon ring is separate, as seen in Fig. 17, and keyed either internally or externally to rotate with the shaft, though free to move endwise. This is backed up by means of a trumpet-shaped rubber washer, the centre of which is located by a collar fixed to the shaft, also forming an abutment for a light spring which presses the carbon ring against a stationary endplate or other flat face. In cases where the pressure at the shaft is negative, the assembly can be reversed so that the inner face of the recess, machined flat, forms the sealing face. The assembly can also be duplicated to deal with both positive and negative pressures. This arrangement is used in the well-known Stuart Turner centrifugal pumps, which have been advertised in this journal for many years, and are extensively used for garden fountains and many other small power applications.

(*To be continued*)

The S.S. "Robert Allen"

THE STORY OF AN 8-ft. RADIO-CONTROLLED CARGO LINER

By Ivan P. Millar

THE idea put into practice is that of an engine-driven compressor delivering air into the fuel tank whilst a leak allows the air to escape. When the engine is running at full speed the air pump " beats the leak " and the pressure rises in the fuel tank until a safety-valve blows (about 30 lb. per sq. in.) thus determining the maximum rate of combustion of paraffin and the engine r.p.m. and the speed of the ship. On the other hand, should the engine be stopped, the leak releases the air until the pressure in the tank drops to a minimum of about 4 lb. per sq. in. as determined by a spring-loaded ball sitting on the exhaust from the leak. In these circumstances, the burner will continue to burn rather feebly and imperfectly, but the safety of the boiler is ensured for at least half an hour, by which time, one hopes, the ship would be recovered.

The leak takes the form of a 3/32-in. needle-valve adjusted to drop the pressure in about 30 secs.

Continued from page 689, *June* 16, 1955.

As described earlier, the compressor has a bore and stroke of ½ in. × ½ in., but probably could have been made with half the capacity. It is provided with a trunk piston with a cup-leather on top and is made with minimum clearances. The small crankshaft is driven by a flat flexible strip of spring-steel set in saw cuts on the two crankshafts concerned.

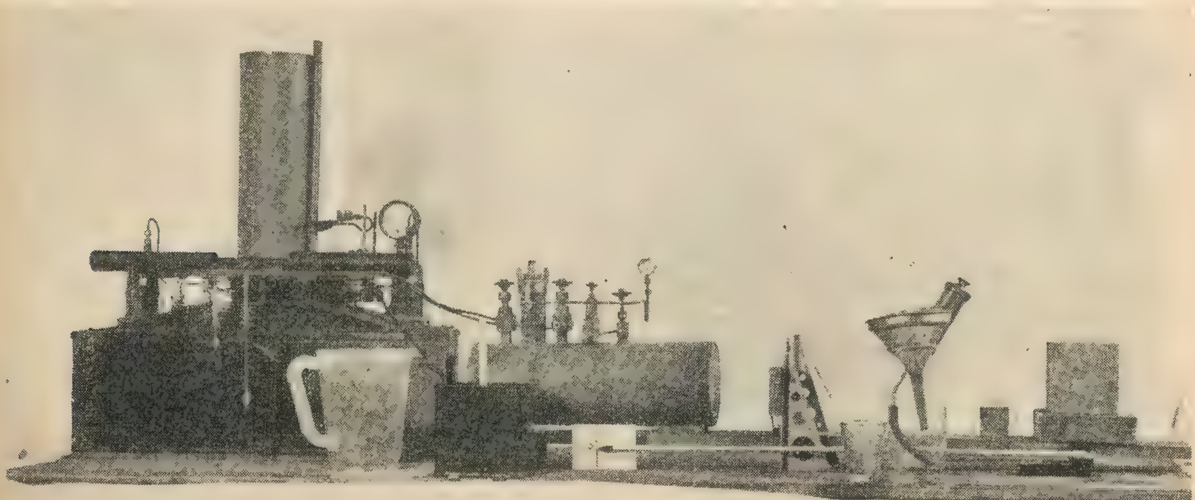
An oil supply pipe is fitted into a compression release cock on the valve pocket. Spring-board ⅛-in. dia. balls form the suction and delivery valves.

The automatic unit comprising " high " and " low " pressure spring-loaded ball valves and the adjustable leak, combined in one block lying in the delivering pipe from the compressor, can be put out of action by the small angle stop valve previously mentioned, as when high air pressure is wanted for starting the burners.

The auto device was, as stated, primarily intended as a safety device, but in practice it also regulates the burners to suit the demand for steam at varied throttle openings, it being first necessary to regulate the " leak " by trial and error. Should the cock be opened too much, the steam pressure will drop and the engine slow down more and more until it eventually just ticks over, and conversely too much steam will be made and the safety valves lift to a greater or lesser degree.

With radio control of the throttle, the auto device proves a great boon, as after once raising steam (by hand air pump on the fuel tank) the ship can be left moored for quite a while with the safety valves just lifting and be all ready to weigh anchor and get under way when desired. Manoeuvring at half speed or so can also be done with the knowledge that the burners are partially shut down, thus avoiding excess steam pressure.

Of course, things oft go agley, much to our shame, as on the first full-speed trials on the Round Pond. With 100 lb. " on the clock," the throttle was opened wide and away she went in fine style. After about 1 min. she gradually came to a stop slewing the while in a beam wind and in a few seconds was blowing off really hard. It dawned on us that in the excitement the auto device had not been opened up and visions of making a new boiler (or ship) became very real, especially when it was recalled that the burners could go on for another two hours. But our plight had been seen by a member of a Model Power Boat Club who had under steam a fine little vessel. A very long line was, in a trice, being towed out some yards past *Robert Allen* on the upwind side and then held tight. The wind carried the struggling little 'un around the big 'un until it fouled in some way thus enabling the pair to be hauled ashore, when *Robert Allen's* burners were shut down. A quick look at the gauge glass showed water when the ship was heeled over, and peace of mind was restored. After tendering proper thanks to our rescuer the cause of the stoppage was sought and it was found that the half-coupling on the shaft had unscrewed, thus pushin



Showing the test rig for boiler trials

the propeller outwards, until it locked against the rudder.

A chorus of voices can be heard to the effect that "the coupling should have been put on with a left hand thread," but in excuse, it might be said that the coupling had been screwed on really hard and had had a split tapered lock-nut jammed in the boss so tight that it was amazing that a small engine could have had enough "urge" to slacken it off. Operations were suspended, but that evening a fat tapered steel pin was driven through nut coupling, shaft and all, and another pin went through the propeller boss and lock-nut too, "just in case."

Propeller (4 in. dia. × 4½ in. pitch)

It is quite simple to determine graphically the angles required at the root and tip of propeller blades. All we did was to get a tall piece of paper and draw a line parallel to and 4½ in. away from the left-hand edge. Another line was drawn parallel to the base 2.35 in. from the bottom edge representing the circumference of the boss. Then a further line drawn from the left-hand bottom corner to the intersection of the two lines mentioned before, gave the angle of the blade at the root, as measured from the lower edge of the paper. In the same way was given the angle of the blade at the tip, and the difference in the two angles as determined gave the angle of twist in any one blade.

As we wished to make all four blades at once a 2 in. wide piece of ⅛-in. copper, 10 in. long, was cut and marked with two scribed lines four blade-lengths apart, with allowance for three saw-cuts. The strip after annealing was then placed with one end in the 4-jaw chuck of a 6-in. lathe and the other in a clamp bolted on the top slide, with the scribed lines just showing. The lathe headstock, in back gear, was then pulled round an amount equal to four times the angle between root and tip of a blade, plus 3 deg. using a large change-wheel on the headstock as a protractor. The saddle was left free to move if contraction in the length of the strip occurred. (The 3 deg. was added for the saw cut spaces.)

The 2-in. strip was then cut up to give four blades, each of which was trimmed square at one end ready to fit into slots end-milled in a ¾-in. dia. brass boss, (already prepared with a centre hole tapped ⅜ in. × 32 t.p.i.). The blades were drilled in the centre 3/32 in. to take an iron banding wire to hold all four blades to the boss during silver-soldering. After pickling, a piece of paper cut to the desired shape was stuck on one blade and a sharp pointed tool used to skim all blades alike in the lathe. The blades were faired off on the back with a file and polished all over after the 3/32-in. holes had been plugged. A streamlined nut was finally prepared to suit the propeller boss.

Propeller Shaft

The original propeller shaft was in ⅜-in. mild-steel (tinned as a precaution against rust) but later, when phosphor-bronze became available, a new shaft was prepared ready screwed 32 t.p.i. to take the inboard half-coupling and the propeller and nut. But, alas, it would not enter the stern tube bushes, being 0.004 in. oversize. This meant that as the bushes could not be readily removed for boring out, the job would have to be done *in situ*.

The old shaft became a boring bar by having set across it a ⅛-in. silver-steel cutter 1/3 the way along locked by a cross taper pin and carefully stoned to a "miked" dimension 1½ thou. bigger than the new shaft. The boring bar was then introduced into the stern tube and carefully rotated with a light carpenter's brace, turning the bar end-to-end to reach the inner gland bush.

Thrust from the propeller is taken by a deep-groove ball-race, ½ in. bore × 1⅛ in. o.d. fitted with a screwed bush to suit the shaft, and bolted in a circular housing to the aft bulkhead.

A disc-type coupling 1½ in. dia. is provided, each half bearing two ⅛ in. pins protruding to engage in holes in a floating disc, one pair of pins being at 90 deg. to the other, all four having oil resisting rubber sleeves to take up back-lash. The front half coupling is driven on to the crankshaft of the engine and fitted with two driven keys located axially, whilst the other is screwed hard against the ball-bearing bush, lock nutted and pinned through.

Test Tank (Wet Dock)

In order to be able to test out the ship in seclusion a "coffin-like" box was made up 9 ft. 6 in. long × 1 ft. 2 in. wide and 10 in. deep from rough-sawn planks, the joints being screwed together with an insertion of cloth steeped in red lead paint. The interior was painted out with bitumastic, and Bostick applied to all crevices. Stiffeners 3 in. × 1 in. were fixed to the sides to counteract bulging when filled with water.

There is no doubt that a tank of this type is of utmost value for checks on buoyancy, stability and trim, whilst it enables trials to be run on all machinery alongside, if not in, the workshop.

If the tank be used indoors, it is recommended not to have it upstairs. If, however, it is so used, don't leave it full overnight or during the next day, or there might be a repetition of a minor catastrophe necessitating a hurried return home as happened once to the writer, who was told on the phone that water was "dripping from the bulb in the hall and also coming downstairs." Panic measures followed and the matter ended with a bill for redecorations, which, of course, had to include a large box of chocolates to the aggrieved one.

Radio-control Gear

Apart from commercial firms, an immense amount of work has been done on radio for models by amateurs all over the world, and those interested would benefit greatly by joining up with the International Radio Controlled Models Society, whose energies are devoted to fostering these activities. Some of the gear turned out by members recently shows remarkable ability in design and craftsmanship and attains electronic heights which the writer will never scale. As a result the gear in *Robert Allen* was made as simple as it could be, and has been modified from time to time in the search for reliability and ease of control. The gear now in use consists of a simple 27-megacycle 2-valve transmitter with a separate controller to send the required "impulses" to a 1-valve receiver in the ship which, in turn, operates a stud-by-stud rotary selector switch to pick out the desired circuit.

This system is neither new nor original but has been improved in detail at intervals to its present stage where ("gremlins," alias "carelessness," alias "accidents" permitting) it works nicely, to the huge delight and astonishment of its progenitors. Of course, there have been times when pride has been wounded and faces have been red, due to one thing or another going wrong; but then we like to think that life would be awfully dull if everything always went according to plan; besides there would be no surprises, pleasant or otherwise, and certainly no chance of cultivating a sense of humour.

Transmitter

This was built some years ago from a kit set of parts obtained from Messrs. Park Radio of Romford and consists of two 3-Q-5 valves with triple tuned air spaced grid and anode coils, the latter having a single turn coil inserted at its mid-point to form the secondary of an h.f. transformer. One end of this coil goes to a quarter-wave aerial rod 8 ft. 4 in. high, whilst the other is connected to a large aluminium earth plate under the transmitter case. h.t. current is supplied by an ex W.D. rotary transformer run from a 6-volt motor-cycle accumulator which also supplies l.t. current for the valve filaments via a variable resistance. A relay inserted in the negative lead of the h.t. supply operates from the controller to send out the required "impulses" during transmission which, of course, is just an interrupted carrier wave, the duration of the impulses equalising the empty spaces between.

Other equipment comprises a main switch and fuses, pilot light, cable sockets, and meters for filament and anode currents. A thermocouple type milliameter is fixed in the aerial connection for testing radiation.

The whole equipment was installed in an old portable gramphone case. It may be as well to add that P.O. licence is now required for the operation of radio-controlled models.

Although the transmitter circuit does not include a crystal for frequency control, the set satisfied the check wave meter of the I.R.C.M.S. and the greatest care is always taken to keep within the prescribed limits of frequency by means of an adaptation type of wave-meter built from an ex W.D. micro-ammeter and germanium crystals. A fresh circuit is contemplated, although the present gives good service, and a crystal is on the list for inclusion therein.

Controller

The controller consists of a box carrying a panel, upon which is fixed the steering wheel column and in which the push buttons for the various functions are set together with the necessary switches, etc. The whole unit is connected to the transmitter by two twin-leads (four-cored flexible cable was not available), one for current derived from the transmitter battery to drive the controller, and one for the operation of the h.t. relay when transmitting.

The heart of the controller is a 24-toothed cam wheel, made from a 2½ in. dia. brass chain wheel sprocket, with a phosphor-bronze spring contact blade which, when rotated, completes a circuit through the h.t. relay thus sounding out 24 evenly spaced pulses per revolution. The contact wheel is carried on a ¼-in. silver-steel shaft which is driven via a 1½ in. driven paper surfaced, spring headed, piston disc clutch by a 12-volt Graham Farish No. 212 "OO"-gauge motor running on 6 volts. The motor circuit includes a switch and a 7 ohm variable resistance set to give 1 rev. per sec. of the contact wheel, thus sending out 24 radio impulses per sec.

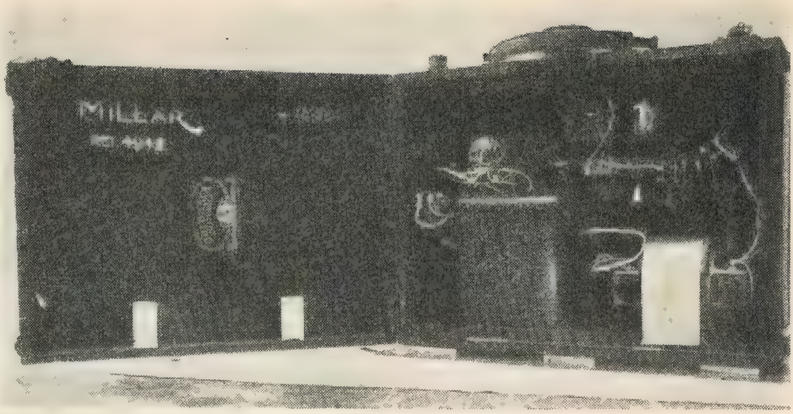
A blade-like arm 4½ in. long attached to the shaft is arrested by a stop set at six o'clock on the panel, the motor continuing to run by virtue of the friction clutch mentioned. A push-button is provided on the panel to free the arm from the stop, when impulses commence to be sent out which on being received by the ship results in the rotary selector switch being stepped round stud-by-stud in unison or synchrony therewith. On release of the button the arm comes to rest at the six o'clock position which tallies with No. 1 stud on the ship's rotary switch, and by means of local contacts white lights show, one on the controller panel and one on the ship's foremast indicating synchrony. A separate push-button contact on the controller enables single pulses to be sent out to actuate the ship's rotary switch until synchrony is achieved

It follows that, to arrest the rotary selector switch in the ship at any desired contact stud, all that is necessary is to provide appropriately spaced push-buttons on the controller panel which, on being pressed, poke through the panel and stop the rotating arm and contact wheel at the same relative position. Provision is made, therefore, for 11 more push-buttons (extra to the synchronising stop and release button mentioned) to control the following circuits in the ship.

Ahead, astern, open throttle, close throttle, navigating lights on, navigating lights off, anchor up and moorings slipped, anchor down, flag up, flag down, and hooter. The remaining 12 positions are reserved for steering, six for port and six for starboard, and are alternately and equally spaced amongst the former 12; corresponding studs on the ship's selector switch are similarly disposed, each set of six studs being in parallel.

To arrest the controller contact wheel at rudder positions, small pads or studs are riveted on the sides of the wheel, six on one side for port and six on the other for starboard, and each set of six has fixed alongside an electro-magnetic catch, or pawl device, which, when the steering wheel is turned one way or the other are caused to flick out, thus stopping the wheel. In this manner, the rotary selector switch in the ship stops on a "port" or "starboard" stud as required, thus starting the rudder motor in one direction or the other. In order to avoid having to press the release button at six o'clock by hand every time the controller is used, a small electro-magnet and lever-type armature is provided to do this job. The push-buttons are accordingly equipped with contacts for this purpose (as in the steering sleeve described later) to energise the coil and let the arm go free until arrested physically by a button or a steering pawl, as the case might be. On release of the button concerned, or if the steering wheel ceases to turn, the arm again becomes free and carries on to the six o'clock synchronising position where it is halted by the stop provided.

From this it will be seen that once the controller is switched on, full control of the ship is attained. The response to steering appears to be almost instantaneous, although the action must take rather less than ½ sec., whilst other functions have a delay of just over 1 sec. at the most to respond.



The transmitter and controller

A small relay, set in the common battery lead in the ship, interrupts all circuits while the rotary switch is moving by the delaying action of a 100 mF condenser fixed across its terminals, so that no circuit is energised until the rotary selector switch arm has stopped for about ¼ sec. In normal conditions, therefore, it takes at the most just over 1 sec. for any circuit to be "livened up" by a push-button, and less than ½ sec. for the rudder to be moved.

The steering wheel in effect is just a two-way switch which energises either of the electro-magnetic catches at will. It consists of a conventional small steering wheel mounted on a column on the controller panel and drives by a small bevel gear the inner of two light tubular concentric sleeves about ½ in. dia. by 6 in. long. The inner sleeve drags round by friction furnished by thinned-out golden syrup (all sorts of oils and greases were tried !). The outer sleeve, which carries at its foot a contact-arm, on movement one way or the other makes contact with appropriate fixed points thus causing the moving contact wheel to be stopped at port or starboard as the case may be. As a centralising spring is fitted to the outer sleeve, contact is broken immediately the steering wheel ceases to be turned—and the rudder motor stops forthwith. This gadget does not presume to give rudder movement proportions to steering wheel movement but simulates the real thing well enough for all practical purposes, as the behaviour of the ship determines how much "helm" is required in any given set of circumstances.

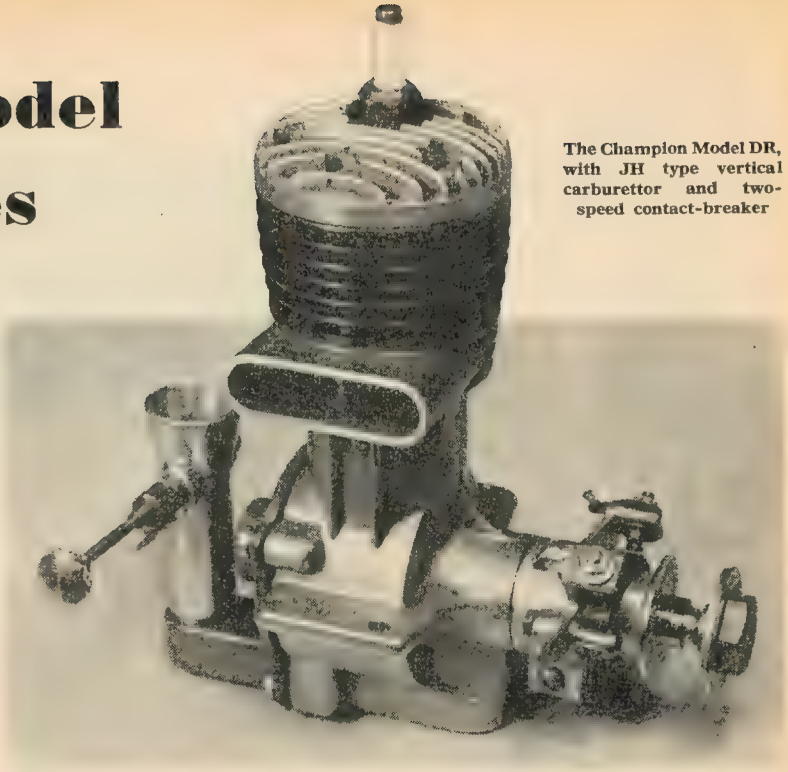
In any case the angle of deflection of the rudder from centre will not alone determine the radius of turn of the ship as other factors, such as the speed of the ship and the slipstream from the propeller, affect the result. It appears, therefore, that it is not important to know how much helm is given, or that the steering is proportional.

(To be continued)

Notable Model I.C. Engines

THE ATWOOD "CHAMPION"

By P. G. F. Chinn



The Champion Model DR, with JH type vertical carburettor and two-speed contact-breaker

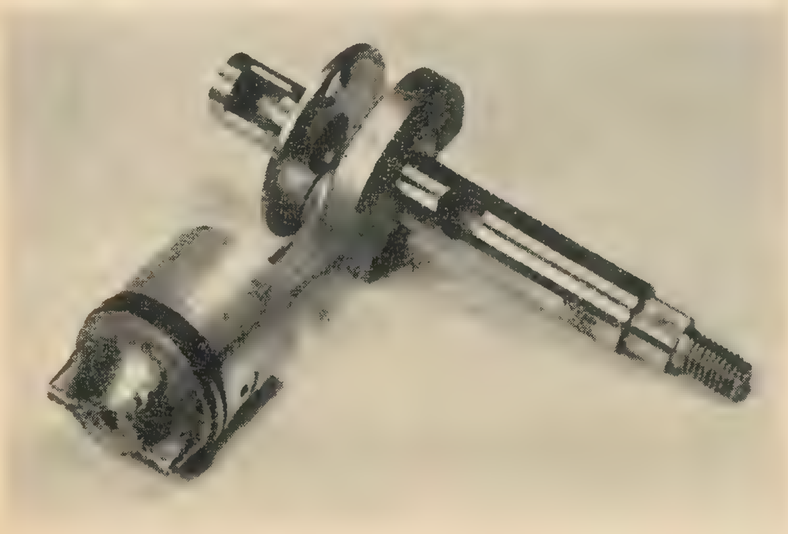
THE story of the American Atwood engines begins more than twenty years ago when, following successes with prototype units, young William E. Atwood, aided, on the business side, by a certain Major C. C. Moseley, produced his famous "Baby Cyclone" engine. Atwood recalls that, prior to this, it was Edgar Westbury's articles in THE MODEL ENGINEER that actually got him interested in miniature internal combustion engines to the extent of building them commercially. In the correspondence that passed between these two pioneers, Atwood revealed a leaning towards the shaft-type rotary induction valve, a layout to which he has remained faithful to this day and which has been widely copied, while E.T.W.'s then new disc valve has, of course, since found equal favour with other producers of high performance model engines.

The list of Atwood-designed model i.c. engines is prodigious, yet it is probably true to say that there has never been a "dud" Atwood engine. The fact that Atwood himself seems to have never lost his interest in models may have something to do with this. In the competition world, he achieved successes in both the model aircraft and model power boat spheres (including a world record or two) although, of recent years, his competition activities have been in a quite different field: that of the microfilm-covered "indoor" model aeroplane. In this gentle art, Atwood, an acknowledged expert, perhaps finds a tranquillity that refreshes him for further tussles with the problems of his stentorian miniatures.

One of the most famous of Atwood engines was the Atwood "Champion." This model, in various forms, was in production over a period of nearly ten years, commencing in 1939/40. Differing widely in detail and continually improved, successive Champion models possessed one unique feature in common; dual rotary-valve induction. In the early models two carburettors were used. In the later types, however, one carburettor fed both valves.

The engine featured in this article is the final development: the Champion Model DR, which was introduced late in 1948. Of slightly over 10 c.c. capacity and weighing only 11¼ oz., this engine, tested for our companion journal *Model Aircraft*, delivered an output of exactly 1.0 h.p. at 12,700 r.p.m., running on a nitroparaffin doped alcohol-castor fuel, a figure unsurpassed by any 10 c.c. commercially produced model engine outside the specialised racing class dominated by Dooling and McCoy.

The Model DR was available in two versions. The Atwood Champion DR was a spark-ignition engine and could also be had with a two-speed contact-breaker assembly. The Atwood Glo-Devil DR was the glowplug ignition version of this. These engines were developed from the Model JH Champion and, compared with this earlier model, had the compression ratio raised from 6.5 to 8.0, a 25 per cent. larger exhaust port area and a 30 per cent. increase in transfer area and volume. In addition,



A unique feature of the Champion were the dual rotary valves. The separate rear valve was driven by the extended crankpin

The complicated but cleanly produced main casting. Note the induction passage formed in the base of the crankcase

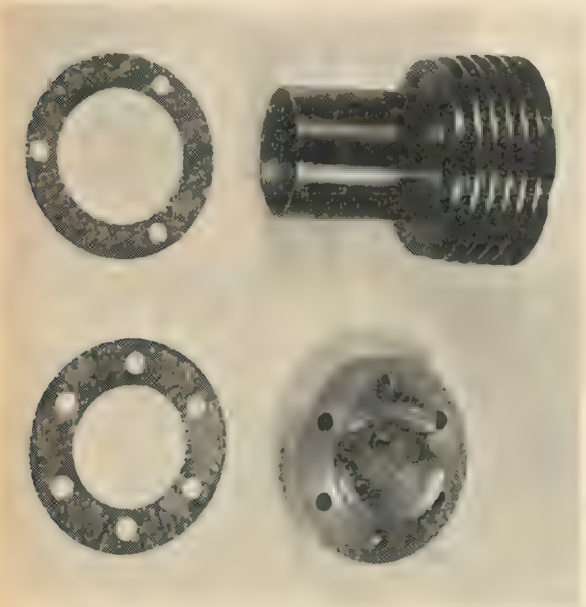
the downdraught carburettor intake was discarded and a straight-through, rectangular section, horizontal intake adopted. If necessary, however, the old type vertical intake could be fitted where installations required this type.

The main casting of the engine was a well executed unpolished diecasting in aluminium alloy and comprised crankcase, beam mounting lugs, main bearing housing and lower part of the cylinder barrel including transfer passage and exhaust duct. Integral also with this was the induction passage to the front rotary valve. The second valve consisted of a special flanged drum or cylinder type rotating in the backplate housing and driven by the crankpin. A glance at the photographs will clarify this description. The backplate was secured by four screws to suitably located crankcase lugs.

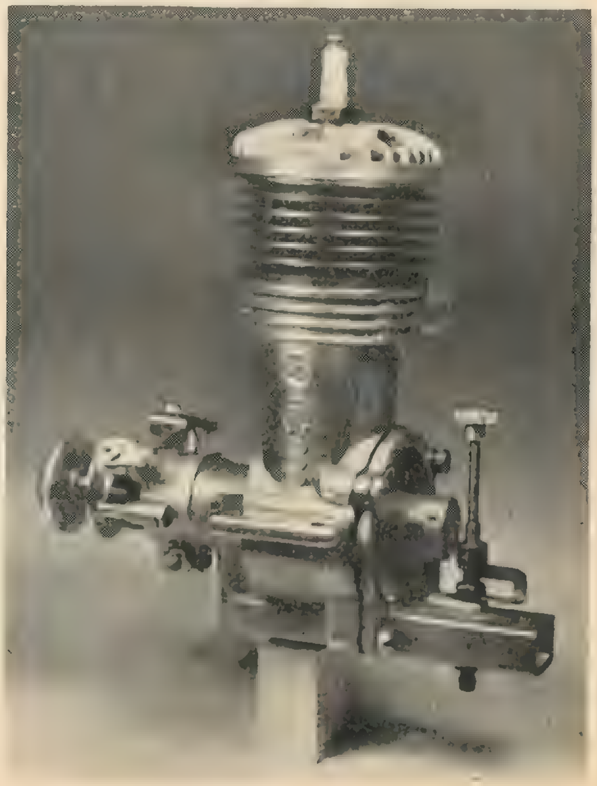
The crankshaft, machined in one piece, was counterbalanced and had a main bearing diameter of $\frac{7}{16}$ in. It ran in an Oilite bronze bearing. The connecting-rod, drop-forged from Alcoa duralumin, was bronze bushed at the big-end. A tubular, full floating gudgeon pin was used, with aluminium end pads. The diecast and machined piston, of aluminium with two compression rings, was of lightweight design, and of a similar domed deflector design to the usual racing type.

The steel cylinder, with integral cooling fins, was amply ported, the exhaust occupying 180 deg. and consisting of six rectangular ports. These were fairly deep and permitted a degree of supplementary air induction below the piston skirt at the top of the stroke. The cylinder-head was diecast in aluminium alloy, with neat longitudinal finning, and was cleanly contoured on the underside to match the piston design. The plug hole was slightly offset to the transfer side. Six screws were used to attach the head to the cylinder, including

(*Continued on page* 717)



The light and efficiently ported Atwood cylinder had integral machined fins. The aluminium cylinder-head was contoured to match the piston-head



Right: The last of the line, the Model DR of 1948 was capable of delivering 1.0 b.h.p. at 12,700 r.p.m., a performance exceeding that of some so-called racing engines of the time

The story of Siegfried Marcus

AN UNSUCCESSFUL ENGINEERING GENIUS

By St. John C. Nixon

I DO not suppose the name of Siegfried Marcus will convey anything to the great majority of readers of this journal, but the name in question was borne by a man who, if nature had only endowed him with perseverance, grit and foresight, might well have been the George Stephenson of the automobile. That much-abused word "genius" which is so often used instead of the more appropriate word "talent" can justly be associated with the name of Marcus, whose engineering gifts were probably greater than those of either Daimler or Benz, whose early work has already been explained in THE MODEL ENGINEER.

If ever there was a striking instance of a man being his own enemy, we have it in the case of Siegfried Marcus. What his versatile brain conceived, his hand made and destroyed—or, perhaps one should say, allowed to wither. While Daimler regarded his first attempts to construct a petrol-driven road-vehicle as nothing more than a stepping-stone towards better things, Marcus, who anticipated him by some eleven years or more, regarded the horseless vehicle as an interesting—one might also say amusing—experiment. That it was destined to revolutionise transport on this planet never occurred to, or even interested, him.

Butterfly-like, he flitted from one invention to another in bewildering haste, never labouring long at the success of one, before he began experimenting with another. This will be appreciated, and his extraordinary versatility realised, when it is recorded that from March 14th, 1857, to May 16th, 1896, no fewer than 38 patents were registered in his name in Austria, and these varied from a new form of safety-valve for a steam engine to a quickly-solidfying compound for filling teeth !

Marcus, the son of a paper-manufacturer, was born on September 18th, 1831, and contrary to common repute he was a German Jew and not an Austrian as many believe. He was first employed by the then newly-formed firm of Siemens and Halske in Berlin, and he played a not unimportant role when the first telegraph cable was laid between Berlin and Magdeburg. In 1860, Marcus set up a small workshop on his own account at 107, Marienhilferstrasse, Vienna, in which he installed a lathe, a drilling machine, operated by the foot, and one or two other pieces of machinery.

He had a highly suspicious nature. He was always haunted by the fear that people would rob him of his inventions, and, for that reason, he never allowed one firm or individual to complete anything he had invented. The work would be handed out to a number of concerns and when the various pieces were completed, the whole would be assembled by Marcus himself behind a locked door, and in no circumstances would he be disturbed. It is even recorded that on one occasion the Archduke Albrecht, a cousin of the Emperor Franz Joseph, called, but Marcus refused to see him for this reason. Marcus, incidentally, fitted one of the first electric bells to be used in Austria—between the bedroom of the Empress and that of her lady's maid.

Let us now examine what role he played in the birth and development of the automobile. There is evidence that he constructed a horseless vehicle as far back as 1864—21 years before Karl Benz—but not a trace of the machine remains. There is in existence one picture of it which shows an ordinary pushcart with a huge two-stroke engine located in front, having a stroke of truly prodigous length. He utilised the rear wheels of the contraption as the flywheel of his engine, and the connecting rod was coupled direct thereto. The hopelessness of the thing will be appreciated when it is recorded that the rear wheels had to be raised from the ground before the engine could be started.

The only evidence that this vehicle ever ran under its own power was an article which appeared in *Die Allgemeine Automobilzeitung* on March 17th, 1901. The total distance it covered was 200 metres, when it broke down, was pushed back, forgotten, and, in due course, broken up.

His second production, of approximately ten years later, and of which there were three examples, is illustrated on this page. This car was discovered after Marcus's death, standing in the Vienna depot of the firm that made it under Marcus's directions, and it can now be seen in the Technisches Museum of that city. It has been run under its own power on more than one occasion in recent times.

The extraordinarily ingenious layout of the engine, and more particularly of the low-tension magneto ignition system, will be at once apparent. The following are the translations or rather explanations of what the words in German indicate as shown in the diagram:—Zündkabel—Ignition wire: Einlassschlitz—Inlet port: Beweglicher Zündstift—Mechanically-operated igniter: Abreisznocken der Zündung—Cam for operatting the igniter: Klinke—Ratchet or clutch for preventing damage in the event of the engine back-firing: Doppel T Anker—Armature: Stromabnehmer—Wipe contact for conveying the low-tension current to the ignition cable: Dauermagnete—Permanent magnets :

The vehicle designed by Marcus in 1875

Magnetzünder—Magneto machine: Kurbelschleife—Arm for operating the semi-rotary armature: Kurbelwelle—Crankshaft: Ventilsteuernocken—Camshaft for operating the valves.

The manner in which Marcus designed his mechanism for operating the igniter is particularly interesting, as this type of ignition with a mechanically-operated igniter was followed until the turn of the century, or slightly later, until it was superseded by high-tension magneto ignition.

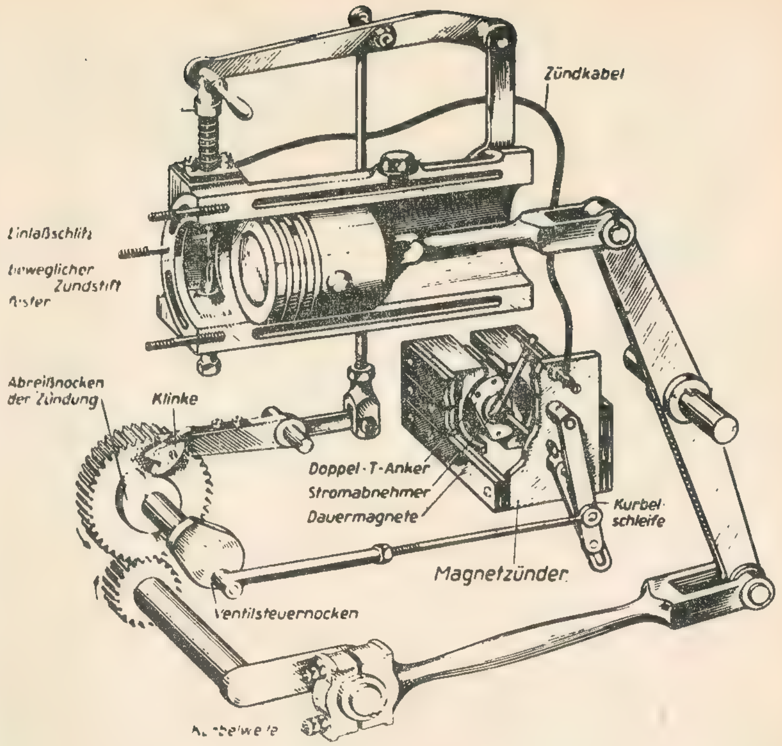
The technical details of this vehicle of 1875 are as follow :—

Horizontal four-stroke single-cylinder engine with a bore and stroke of 100 mm. and 200 mm. respectively; cubic capacity 1,570 c.c. Both inlet and exhaust valve were mechanically operated, the inlet being of the sliding, and the exhaust valve, of the poppet types. With the exception of the cylinder, all lubrication was by hand. Maximum r.p.m. 500; minimum 200. Maximum h.p. 0.75. Position of piston in the cylinder when detonation took place, top dead-centre. Fuel, Benzin (petrol). Carburettor of the early surface type, but fitted with a revolving brush to provide the necessary turbulence, somewhat like the revolving brush of a vacuum cleaner. One speed with a ratio of 1 to 6.7 giving a maximum road-speed of 6 k.p.h. Chassis-frame made of oak; front axle fitted with half-elliptic springs; rear axle also sprung with rubber buffers. Iron tyres. Wooden wheels with spokes. Block brakes. Lever-operated clutch of the steel-cone type. Carburettor mixture regulated by a small wheel operated by the hand. Hand brake operated from the driver's seat. Weight of engine without fuel or water, 280 kg.; weight of chassis. 476 kg.; total weight without fuel and water, 756 kg.

Three of these vehicles were made: one is said to have gone to America, one to Holland and the third is preserved as explained.

Despite all this, however, the net value of Marcus's efforts on automobilism was nil. The development of the petrol-driven vehicle would not have been retarded by a single inch nor by an hour in point of priority if Marcus had never been born, and this surely is the true test of an early effort.

The same cannot be said of either Benz or Daimler; they both foresaw the immense future before the horseless vehicle and they laboured on in spite of set-backs and difficulties, whereas Marcus with all his genius never took the automobile seriously.



The low-tension magneto ignition system designed by Marcus and used on his second vehicle of 1875

NOTABLE MODEL I.C. ENGINES

(*Continued from page 715*)

three which passed through the cylinder fins and secured the entire assembly to the crankcase.

The fits of all parts on the Champion were to high standards. The main bearing was excellent, as were the big- and little-ends and the rear rotary valve. The engine was undoubtedly a "happy" design. Despite its relatively light weight (which, incidentally, gave it a power/weight ratio still seldom equalled) Atwood did not fall into the error of reducing weight in the wrong places and causing overheating, distortion and loss of power. Nor was power loss through differential thermal expansion avoided by merely making clearances larger. As we have said, fits were excellent, and a brand new Champion, even before the rings had bedded properly, would start easily, yet, at the same time, could, if necessary, be run at a high speed immediately without risk of seizing or of the slightest power loss.

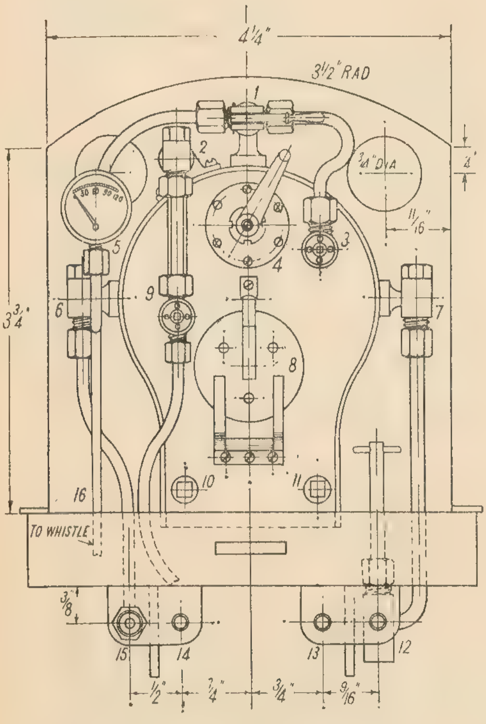
The contact-breaker assembly was carried on a diecast alloy spring-loaded clamp fitting, on a suitably machined nose section of the crankcase, and the cam to operate the points was combined in the airscrew drive collet, which was keyed in position by suitable flats on the front of the crankshaft. The contact-breaker was quickly removable when it was desired to operate the engine on glowplug ignition, or could be replaced by a special twin contact-breaker unit. Both types of contact-breaker were adjustable for advance and retard, but the twin type included an extra set of points following the first. Switching to these retarded points thus slowed the engine, a useful feature for radio-controlled or certain types of control-line models. Usually fitted to these engines was the Champion VR.2 sparking-plug, or, in the case of the glow-plug model, the Champion VG.2.

The Atwood Champion had a bore and stroke of 0.940 in. by 0.900 in., giving a swept volume of 0.624 cu. in. or 10.23 c.c. To quote Bill Atwood, it was a "dependable old banger." By our own experience, it was one of the finest factory-made model engines of all time.

L.B.S.C.'s "Netta"

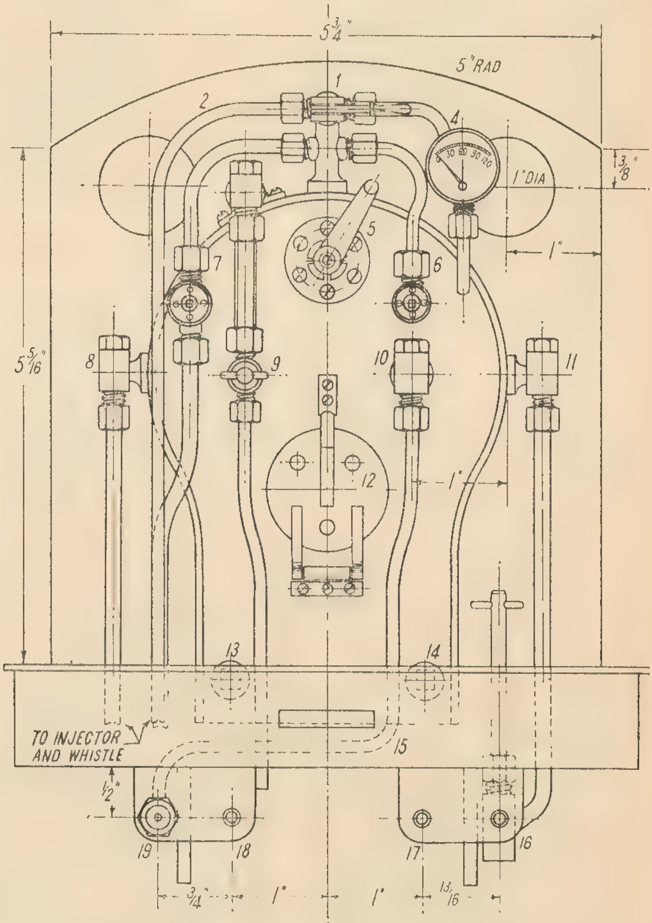
FOOTPLATE FITTINGS, $2\frac{1}{2}$-in. AND $3\frac{1}{2}$-in. GAUGE ENGINES

THE next item in the building of the *Netta* quins, will be the blobs and gadgets for adorning the backheads; and in a further effort to avoid waste of time and space, I have drawn out the complete arrangement of both $2\frac{1}{2}$-in. and $3\frac{1}{2}$-in. gauge footplates, and included the cab fronts or weatherboards, and the pipe connections under the drag beams. We shall be able to refer back to these items, when we get towards the final stages of erection. The fittings themselves have come to be known as "L.B.S.C. standard," as I have specified fittings of a similar type for practically every locomotive described in these notes; and for beginners' benefit, would repeat that they are the result of very many years' personal experience. At the time I started to write, very few locomotive-builders made their own fittings, and those sold by "model" firms were of a very antiquated type, ugly, leaky, and inefficient; so I did a bit of experimenting, and builders now reap the results. In passing, I might mention that it was a case of being



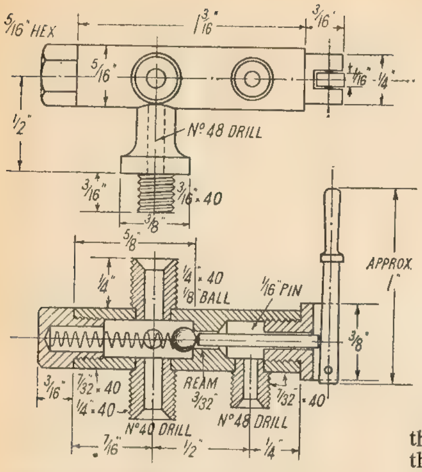
Footplate fittings for the $2\frac{1}{2}$-in. gauge engine

1. Turret and Whistle Valve. 2. Water Gauge Upper Fitting. 3. Blower Valve. 4. Regulator. 5. Steam Pressure Gauge. 6. Hand Pump Feed Clackbox. 7. Eccentric Pump Clackbox. 8. Firehole Door. 9. Water Gauge Blowdown Valve. 10. Washout Plug. 11. Washout Plug. 12. Bypass Valve. 13. Connection for Pump Feed. 14. Connection for Injector Feed (if fitted). 15. Union for Hand Pump Connection. 16. Steam Pipe to Whistle



Footplate fittings for the $3\frac{1}{2}$-in. gauge engine

1. Turret and Whistle Valve. 2. Steam Pipe to Whistle. 3. Water Gauge Upper Fitting. 4. Steam Pressure Gauge. 5. Regulator. 6. Blower Valve. 7. Injector Steam Valve. 8. Injector Feed Clackbox. 9. Water Gauge Blowdown Valve. 10. Hand Pump Feed Clackbox. 11. Eccentric Pump Clackbox. 12. Firehole Door. 13. Washout Plug. 14. Washout Plug. 15. Hand Pump Feed Pipe. 16. Bypass Valve. 17. Connection for Pump Feed. 18. Connection for Injector Feed. 19. Union for Hand Pump Connection



Turret and whistle valve for the $2\frac{1}{2}$-in. gauge engine

between the devil and the deep sea, to quote an old saying, to scheme out fittings that were not only neat and small, but able to do the job as well. I have seen, on more than one occasion, a photograph of a footplate with elaborate fittings which looked very pretty, but were so leaky and inefficient when the engine was tried under steam, that they all had to be replaced by something less glamorous, but more serviceable. My aim has always been utility combined with neatness.

As mentioned in a previous note, the fittings for the $2\frac{1}{2}$-in., $3\frac{1}{2}$-in. and 5-in. gauge engines are "much of a muchness"; how much, can be seen from the illustrations of the footplates reproduced here. To avoid overcrowding the backheads, I have arranged for the feed clacks to be fitted at the sides of the wrapper, and they can be screwed into the wrapper, close to the backhead, so that the threads take a "bite" in the backhead flange. Two only are needed for the $2\frac{1}{2}$-in. gauge engine; if an injector is fitted to this size, I will show, in a future illustration, how the feed can be arranged to tee into one of the side clacks. In the case of the $3\frac{1}{2}$-in. gauge job, there is room for a separate clackbox on the backhead, under the blower valve and clear of the reversing lever. I'm not particularly keen on putting a clackbox in such a position that the discharge from it squirts directly on the firebox doorplate; but in this case my conscience is clear, because I've arranged it to take the feed from the emergency hand pump. If the driver knows his job, this pump will never have to be used when the engine is in steam. Incidentally if I built the engine myself, I should put the side clacks on the boiler barrel, for the injector and pump feeds, in the usual position near the smokebox. I believe big sister had either two combination injectors on the backhead, or one combination on the backhead, and one exhaust injector under the left-hand step.

Differences in Turrets

It will be noticed that the section of the turret containing the whistle valve, is the same on both the given sizes, but there is some difference in the stems or columns. Naturally there isn't much headroom under the cab roof on the $2\frac{1}{2}$-in. gauge engine, so I have specified a low turret, with three unions, for blower, steam gauge, and whistle. If any builder of the $2\frac{1}{2}$-in. gauge wants to fit an injector, the steam for operating it can be taken from the union shown connected to the steam gauge, and the latter attached to a separate fitting, as it doesn't matter how low down the connection for the steam gauge is fixed; but the injector needs dry steam. I'll deal with the alteration later, if all's well. In the $3\frac{1}{2}$-in. gauge size, we have bags of headroom, so I am specifying a tall column with two extra outlets, one at either side. One of these outlets conveys steam to the blower valve, and the other to the injector steam valve. The latter has a "blind" spigot which is screwed into the boiler backhead, merely as a support. One of the unions on the "top floor" is connected to the steam gauge, and the other will be connected to the driver's brake valve, for operating the steam brake, which can easily be fitted to the $3\frac{1}{2}$-in. and 5-in. gauge engines if desired. Details of brake gear will follow on in due course, as I can deal with both $3\frac{1}{2}$-in. and 5-in. sizes together.

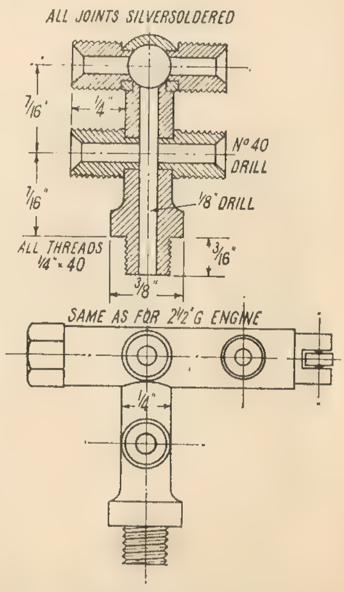
The only difference in the water gauges of the three larger quins is in the length of the glass. Both those shown here have the top fitting screwed into a socket attached to the wrapper on the left-hand side of the turret. A steamway is drilled in this, and another in the wrapper, to match up with it; and this arrangement not only allows the gauge to be fitted vertically, but ensures true readings at all times.

The regulators and blower valves have both been dealt with; if the "ram's-horn" regulator handles are fitted to the regulators, they will naturally have to be bent outwards considerably, to clear the adjacent fittings, and personally I would prefer the type of handle shown, which at one time was practically universal. Whilst I am not in favour of drop-down firehole doors, I have shown this type, as the full-sized engines had them, and it works in very well with the pipe arrangements. The long hinge allows the door to swing well clear of the backhead, and minimises the chances of pieces of coal lodging on the door and preventing it from closing. A spring catch is provided, although the blast action, when the engine is working hard, would keep it shut; and the handle is hooked, so that it can be easily operated with the fireman's shovel when firing on the run. The bypass valve is of the simple screwdown type, with a long handle which projects through the footplate, just behind the reversing lever; and two washout plugs are provided, as shown, although an Everlasting blowdown valve can be fitted if desired. Some of the fittings are shown here in detail, and the rest will follow, if all's well.

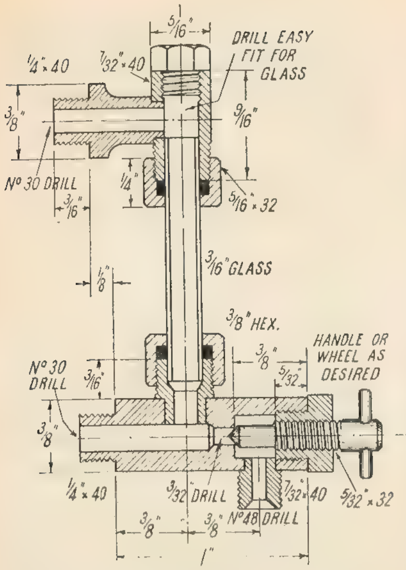
How to Make the Fittings

The body of the whistle-valve section of both turrets is a piece of $\frac{5}{8}$-in. round brass rod, faced at both ends in the lathe, to a length of $1\frac{3}{16}$ in. Chuck in three-jaw, centre, and drill about $\frac{7}{8}$ in. depth with No. 43 drill. Open out and bottom to $\frac{3}{8}$ in. depth with $\frac{3}{16}$-in. drill and D-bit, slightly countersink the end, and tap 7/32 in. × 40 for about $\frac{3}{16}$ in. down; skim off any burring. Reverse in chuck, centre, drill to $\frac{7}{16}$ in. depth with $\frac{3}{16}$-in. drill, and tap 7/32 in. × 40 for a full $\frac{3}{16}$ in. depth. Put a 3/32-in. parallel reamer through the remains of the No. 43 hole. At $\frac{7}{16}$ in. from the D-bitted end, drill a 5/32-in. hole right across; and at right-angles to these, drill another one, breaking into the centre hole. At $\frac{1}{4}$ in. from the other end, and in line with one of the holes first drilled, drill another 5/32-in. hole, in which is fitted a 7/32 in. × 40 union nipple (see section). In the two side holes, fit $\frac{1}{4}$ in. × 40 union nipples, and in the bottom hole, fit the stem or column.

In the $2\frac{1}{2}$-in. size, this is turned from a bit of $\frac{3}{8}$-in. brass rod held in three-jaw. Face, centre, and drill No. 48 for about $\frac{7}{8}$ in. depth. Turn down $\frac{3}{16}$ in. of the outside to $\frac{3}{16}$ in. diameter, and screw $\frac{3}{16}$ in. × 40. Part off at a full $\frac{5}{8}$ in. from the shoulder, reverse and rechuck in a tapped bush held in three-jaw, turn the outside to the shape shown, and turn down $\frac{1}{16}$ in. of the end,



Turret and whistle valve for the $3\frac{1}{2}$-in. gauge engine

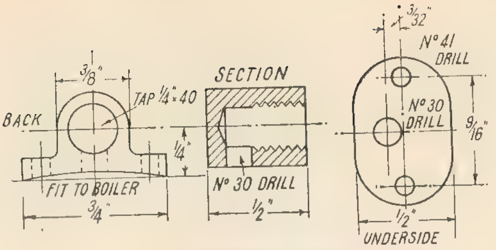


Water gauge for the $2\frac{1}{2}$- and $3\frac{1}{2}$-in. gauge engines

to a tight fit in the hole in the valve body. In the $3\frac{1}{2}$-in. size, chuck the $\frac{3}{8}$-in. rod as before, but centre and drill to a full 1 in. depth with $\frac{1}{8}$-in. or No. 30 drill. Turn down $\frac{3}{16}$ in. of the end to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. $\times$ 40. Part off at $\frac{13}{16}$ in. from the shoulder, rechuck in a tapped bush, turn the outside to $\frac{1}{4}$ in. dia. as shown, and turn the end to fit the valve body as above. At $\frac{7}{16}$ in. from the shoulder, drill a 5/32-in. hole right across the column, and fit a $\frac{1}{4}$ in. $\times$ 40 union nipple in each side as shown in the section. The column can then be fitted to the valve body; and all joints on either size, can be silver-soldered at one heating.

After pickling, washing off, and cleaning up, seat a $\frac{1}{8}$-in. rustless ball on the 3/32 in. reamed seating. The end cap is turned from $\frac{5}{16}$ in. hexagon rod, screwed 7/32 in. $\times$ 40 and drilled up to take the spring, using $\frac{1}{8}$-in. drill. The spring is wound up from hard brass or bronze wire, around the shank of a No. 43 drill; it doesn't need to be very strong, so about 26-gauge wire would do. The plug which carries the lever, is turned from $\frac{3}{8}$-in. hexagon rod held in three-jaw. Face the end, centre, and drill No. 51 for about $\frac{7}{16}$ in. depth. Turn down 5/32 in. of the end to 7/32 in. diameter, and screw 7/32 in. $\times$ 40. Part off at $\frac{3}{16}$ in. from the shoulder. File or mill the end to a $\frac{1}{4}$ in. $\times$ $\frac{3}{8}$ in. rectangle as shown, then slot across, to take the lever. The slot should be a full $\frac{1}{16}$ in. wide and a full $\frac{1}{8}$ in. deep. I usually screw the piece into a tapped hole in the end of a short length of square rod, which is held in a machine-vice on either the miller or planer table, while forming the slot with a saw-type cutter on the miller, or a parting-tool in the clapper box on the planer; but it *can* be done by judicious use of a file ! The lever is easily made by chucking a short length of rustless steel or nickel-bronze (German silver) in the three-jaw, and turning the grip to shape shown; then saw or part off about $\frac{5}{8}$ in. from the grip, and file a flat on each side until the lever fits the slot easily.

The push rod is a piece of $\frac{1}{16}$-in. bronze wire cut to such a length that it just projects into the slot when touching the ball; see section. The lever is then fitted into the slot, and pinned as shown, so that it depresses the push rod when pressed right home, forces the ball off its seating and allows steam to pass to the whistle pipe. Tip: don't pin the lever too close to the end of the slot, otherwise the lever will fly right back as soon as released, and the push rod will shoot clean out. If pinned as shown, the tail end of the lever will catch against the end of the slot and act as a stop. I use bits of domestic blanket pins for pivots for these levers, for which No. 57 drill makes just the right size hole. The lever must not be tight, it should work quite freely. The hole on top of the wrapper, into which the turret is screwed, is drilled and tapped on the centre-line above the regulator, as close to the edge as possible, so that it passes through the backhead flange and affords a good depth of thread. I usually pindrill a slight flat around the hole, so that the flange seats home truly; judicious application of a file will also do the trick, plus a smear of plumbers' jointing.



Water gauge socket

Water Gauge

The upper fitting of the water gauge is screwed into a socket made from a piece of brass, sawn and filed to the shape shown. You know how Pat builds a barrel by putting some bits of wood around a bunghole; well, drill and tap the hole in the block of brass first, and then file it to outline around the hole. The underside is slightly radiused to bed down on the boiler, and a No. 30 hole drilled to let steam into the tapped hole, as shown. The socket is fitted to the boiler, with the tapped hole exactly above the hole into which the bottom fitting of the gauge is screwed, line-and-line with the edge of the wrapper. Drill a No. 30 hole in the wrapper, to match up with the one in the base of the socket, then attach the socket to the wrapper with two 3/32-in. or 7-B.A. brass screws; as the socket won't need removing any more, during the lifetime of the engine, the joint can be sweated with soft solder, and rendered permanently leakproof.

I've described my pet type of water gauge so many times, that there is no need to go into full detail again; neither is there any sense in spreading the details all over the page, as the whole doings is presented clearly in the single sectional drawing. The upper fitting is a $\frac{9}{16}$ in. length of round rod (bronze or gunmetal for preference, though brass does at a pinch) drilled and tapped as shown; the part which screws into the socket on the boiler, is made in the same way as the stem of the $2\frac{1}{2}$-in. gauge turret.

For the bottom fitting, chuck a piece of $\frac{3}{8}$-in. round rod in the three-jaw, face the end, centre, and drill to $\frac{11}{16}$ in. depth with No. 30 drill. Turn down $\frac{3}{16}$ in. of the end to $\frac{1}{4}$ in. dia., and screw $\frac{1}{4}$ in. $\times$ 40. Part off at 1 in. from shoulder, reverse in chuck, centre, run a 3/32-in. drill in, until it breaks through into the hole previously drilled, open out and bottom to $\frac{3}{8}$ in. depth with $\frac{3}{16}$-in. drill and D-bit, and tap the end 7/32 in. $\times$ 40. At $\frac{1}{4}$ in. from the tapped end, and $\frac{3}{8}$ in. from the screwed end, drill 5/32 in. holes diametrically opposite, and silver-solder screwed nipples in them as shown; fit a plug in the tapped end, tapped to take a valve pin of the same pattern as fitted to the blower valves. The gland nuts are exactly the same as union nuts. When erecting, line up top and bottom fittings with a $\frac{3}{16}$-in. drill shank put down the top fitting into the counterbore in the bottom one; it should drop right in, when both fittings are screwed right home, as the glass must be perfectly free. The glass should be cut so that when in place, it rests on the bottom of the counterbore, and is just clear of the steamway in the top fitting, as shown in the sectional drawing. Note that the seating of the top fitting projects farther from the glass, than the bottom one, owing to the socket not being flush with the backhead. The packing rings are slices of rubber tube; for beginners' benefit, put an inch of rubber tube on a piece of $\frac{3}{16}$-in. rod, hold in three-jaw, run the lathe fast, and apply a wetted discarded safety-razor blade to the tube at 3/32 in. intervals. When you push the rubber tube off the rod, it will fall into rings. Put the glass tube down the top fitting, put a wetted ring on it, then the two nuts back to back, then another wetted ring. Push the glass down into the counterbore, and screw the nuts home with the rings inside them; little more than finger-pressure will be needed, to keep them steam-and-water-tight. Details of other fittings to follow.

QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Jointing Band Saw Blades

Can you please give me any information on the best method of jointing metal-cutting band saw blades? Oxy-acetylene welding plant is available, also a resistance welding transformer rated at 4 *volts,* 1,000 *amperes. Have any articles on band saw machines appeared in* THE MODEL ENGINEER?

D.C.H.G. (Burnham-on-Sea).

The usual method of carrying out this operation is by means of resistance welding, or in some cases, by brazing.

Some of the metal-cutting band saw machines incorporate a resistance welding device in the machine itself. We believe that in some cases high frequency heating has been used for brazing or welding blades, but we have no exact details of any of the apparatus employed.

We should not think that oxy-acetylene welding would be very suitable for this particular purpose.

We have not published any articles on band saw machines incorporating the information you require, but it is possible that you may obtain more information on the matter from a journal which deals with industrial machine tools.

Adapting Domestic Boiler

I am proposing to adapt a boiler which, I understand, was taken from a domestic cooking range, for the purposes of driving small steam engines. The boiler measures $15\frac{1}{2}$ *in.* × 4 *in.* × 4 *in., is constructed of copper, and weighs* 23 *lb. It has two openings approximately* $\frac{3}{4}$ *in. diameter at one end.*

(*a*) *Could you enlighten me as to the internal construction of the boiler?*

(*b*) *Would it be suitable for steaming a Stuart No.* 10 *engine, or other engines of similar size?*

(*c*) *What maximum pressure would you recommend?*

(*d*) *If it is unsuitable for the above purpose, could you advise me as to how it could be reconstructed in a suitable form?*

S.M. (Monaghan, Ireland).

We are inclined to doubt whether this particular boiler would be suitable for withstanding pressure, in view of the fact that it is rectangular in shape. This shape is not well adapted to resisting pressure unless stayed in two or possibly three directions.

(*a*) We cannot give you any information on the internal construction of the boiler without actual examination of it, but we presume that it would be entirely without internal fittings and that the joints would be brazed.

(*b*) The suitability of the boiler for steaming an engine could only be determined by actual experiment, subject to a preliminary pressure test; the working pressure should not exceed 60 per cent of the test pressure which the boiler will withstand without distortion.

(*c*) We cannot advise you of what pressure the boiler would stand, and the only way to ascertain this safely is by means of a hydraulic pressure test, which can be applied quite easily by filling it completely with water and applying pressure from a small pump, such as the type of hand pump used in the tender of a model locomotive.

(*d*) We cannot give you any advice on reconstruction without more exact particulars of the boiler.

Drilling Machine Spindle Bearings

I have built a $\frac{1}{4}$ *in. power-operated bench drilling machine fitted with a* $\frac{1}{2}$ *in. dia. mild-steel spindle running in cast-iron bearings, and should be pleased to have your advice as to whether it is necessary to case-harden the spindle. The only side thrust on the bearings is that due to the tension of the driving belt.*

R.W. (West Wickham).

It is perfectly in order to use an unhardened mild-steel spindle, running direct in a cast-iron bearing, provided that it is carefully run in with ample lubrication, preferably containing colloidal graphite.

Once the spindle has been run in, it will work satisfactorily with very little lubrication, and will give a long life without appreciable wear. While it is definitely an advantage to use a hardened spindle, there is considerable risk of distortion in the process of hardening, and unless you have means of precision grinding the spindle after hardening, we think it would be a risky undertaking.

Spring Steel Wire

Can you please tell me where to obtain tinned or rustless-steel spring wire in gauges from 18 *to* 24? *I want to obtain some for making safety-valve and axlebox springs, so that bronze wire is not considered suitable.*

F.J.B. (Coventry).

We cannot advise you where to obtain tinned steel spring wire, but some of our advertisers can supply rustless-steel wire in certain gauges, including:—

Messrs. Bond's o' Euston Road, 357, Euston Road, London, N.W.1.

Messrs. A. J. Reeves, 416, Moseley Road, Birmingham, 12.

Messrs. Kennion Bros., 2a, Railway Place, Hertford.

Incidentally, phosphor-bronze spring wire is quite suitable for safety-valve and axlebox springs, according to the experience of our locomotive constructor readers.

AN ALL-FABRICATED LATHE HEADSTOCK

(*Continued from page* 703)

plate, or thereabouts, and brazed together, will prove adequate. Cardboard templates are useful when cutting out the plate, and it takes but a few minutes to make one; paper is not really stiff enough, and I always keep one or two empty boxes from which to obtain material in my workshop.

Finally, run the machine for about a week, and then check over the fit of both the front and rear bearings. While doing so, examine pieces produced by the lathe—checking the diameters on a shaft and the flat surface on a piece faced on the faceplate. The latter should not have any waves or chatter marks, but the face should emerge as the tool passes over, perfectly smooth and flat—a very important point is this question of flatness, but do see that the faceplate is true before carrying out this work.

Those remarks cover all the points which I think need be considered—many details will depend on the make of your present lathe or the size of the one you anticipate building. Frankly, this is hardly the job for tyros, but twelve months from now I shall fully expect someone with a 3-in. non-back-geared lathe, and with only a couple of months experience, will write and tell us he found the work easy. I have long since given up being surprised at some of the antics readers get up to, so here is your Milnes headstock—it will prove the best investment in your workshop.

READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

SLOW SPEED WITHOUT SLIP

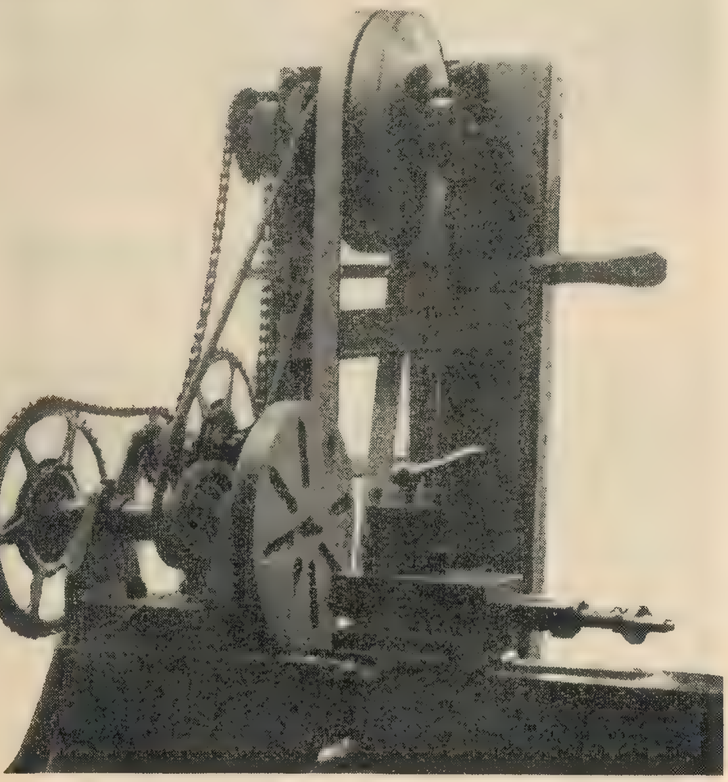
DEAR SIR,—Desiring the need for a slow speed, high torque on my plain lathe without back gear, I utilised chain wheels and sprockets as fitted to an ordinary bicycle.

I fitted one sprocket (22 teeth) to the countershaft, which in turn drove a 48-tooth chain wheel fixed to a bicycle rear hub complete with spindle and bearings. The other side of the hub had an 18-tooth fixed wheel sprocket, which in turn drove a 48-tooth chain wheel mounted on the end of the lathe mandrel. I thus obtained a speed of 25 r.p.m.

By varying the number of teeth on the sprockets, different speeds can be obtained. A suitable bracket was made to hold the standard rear hub in any convenient position. When the back gear is not required, the countershaft chain is taken off, and the chain wheel on the mandrel is wrapped round with a piece of chain, so nothing can be caught up.

I have used this method for a number of years and have no trouble at all. My lathe, incidentally, is home-made.

Yours faithfully,
London, S.E. R. L. HOARE.



DEGREASING PLANTS

DEAR SIR,—In the interests of safety, perhaps it would be advisable to draw the attention of your querist "R.S.L." and any others who may construct trichlorethylene vapour degreasers, to the fact that the vapour is somewhat anaesthetic, so the workshop should be ventilated, and inhaling the fumes should be avoided.

But more important, NO SMOKING, and NO FLAME LIGHTS, please, as the vapour decomposes in the flame to form very harmful chemical fumes.

Yours faithfully,
Salisbury. R. BENTLEY.

ELECTRICAL EARTHING

DEAR SIR,—Whether Mr. C. R. Cosens agrees or not, the fact remains that the regulations for earthing apply to any building or workshop whether amateur or otherwise. The people that compile these regulations are not "playing at shops"; they are setting out a standard for safety. No electrical contractor is bound by any grandmotherly regulations in any shape or form, and no contractor worth his salt would depart from these rules as set down.

I am afraid Mr. Cosens has missed the point so far as fusing is concerned; if he refers to my article, he will learn that it is possible to have an appreciable earth current flowing without blowing the particular fuse. Some users of electrical apparatus unfortunately do not know or observe these rules where fuses are concerned, hence the finding of conditions as stated in my article.

I happen to be a repair and faults electrician, with over 40 years practical experience, and I know what one can meet in the way of fusing. It is for the above users that the rules are chiefly concerned. No one except an expert would be so foolish as to attempt to carry out repairs on live apparatus. Then again, one does not have to be *wet* in a bathroom to enable himself to get killed; it would only be necessary to touch any metal object in connection with earth to receive a fatal shock. As for the regulations, they do not allow any unprotected apparatus in a bathroom for this reason.

I have read with interest Mr. R. E. Hawkes's letter referring to my article on earthing; I have no comment to make, except to say that I think his remarks are sensible.

Yours faithfully,
Enfield. J. W. COOPER.

EARTH WIRING

DEAR SIR,—In reply to the letters in the June 2nd issue, I agree entirely with R. E. Hawkes's layout of rules, but I would point out that these are the products of careful study by engineers, for the correct distribution of electrical power throughout the country, and not as he suggests, just a set code for contractors, under compulsion by law, to work to.

Fortunately C. R. Cosens' instructions are only followed by the minority, and may I suggest that if more attention were given to the rules of the game, it would counteract or maybe banish entirely: (1) Accident by electricity; (2) Radio and television interference.

For my final words, may I add that earth wiring is used for assisting the neutral wire in the return of out-of-balance currents to the generator. If, as it has been suggested, bell wire was used by the majority, the electrical distribution board would spend almost their entire time repairing neutral breakdowns on their grid systems. As space is limited, and theory of out-of-balance currents can become very involved, particularly where single-phase workshop operators are concerned, my advice is to learn and to work to the rules, and so pave the way to safer handling of any electrical apparatus.

Yours faithfully,
Coventry. D. BELL.

WITH THE CLUBS

Kegworth Carnival and Traction Engine Rally

We shall be holding our Lionel Traction Engine Rally at our Carnival on Saturday, July 23rd; we have 11 engines entered at the moment including showmen's, Fowler, Burrells, Ransomes, Claytons, etc. We shall also have a model tent with a good display of model engines, some in steam; also, we shall have a photograph section.

This is the only rally held in the Midlands, and should be of great interest to the local model engineers.

The carnival and rally will start with a mammoth parade of the engines, etc., through the streets of Kegworth at 3.0 p.m.

Secretary: Miss Ann Stevenson, Long Lane, Kegworth, near Derby.

Stephenson Locomotive Society

The society has arranged a special train tour over the scenic narrow gauge Vale of Rheidol light railway in Central Wales operated by British Railways, Western Region, on Sunday, July 17th, departing from Aberystwyth about 2.30 p.m. in connection with half-day excursions from Birmingham (Snow Hill dep. 9.55 a.m.), Manchester (Exchange) and Chester. Passengers from the Merseyside area and Liverpool can travel *via* Chester. There will also be visits to Machynlleth & Aberystwyth Motive Power Depots. Non-members will be welcome as far as accommodation permits. Tickets for the Devils Bridge run must be procured in advance from S.L.S. Rail Tours: 16, Hutton Road, Handsworth, Birmingham 20, enclosing stamped, addressed envelope and postal order value 2s. 9d. Participants to obtain their own half-day tickets to Aberystwyth from starting point.

General Secretary: H. C. Casserley, Ravensbourne, Berkhamsted, Herts.

The Marlborough S.M. & E.E. (New Zealand)

The second of two talks on Measuring Instruments and Appliances was given by Mr. E. J. Speight at the regular monthly meeting of the above society.

In this talk Mr. Speight dealt with the practical applications of the principles covered by his first talk, and he demonstrated and explained the uses of a wide variety of tools and appliances, from a 12-in. steel rule to an optical flat and a very modern theodolite.

Hon. Secretary: J. E. Robinson, Scotland Street, Picton, New Zealand.

Eltham & District Locomotive Society

The next meeting will be held at the Beehive Hotel, Eltham, on Thursday, July 7th, 1955; this will be a talk by Mr. Hutton which was postponed at the last meeting. The society are now busy with public tracks runs, etc., and it is hoped that our chairman's locomotive will be showing its paces on some of the occasions. It is also hoped to have two more Club Days at the permanent track, Avery Hill Road, Eltham, about August. Visitors are always cordially invited to these sessions and the meetings.

Hon. Secretary: F. H. Bradford, 19, South Park Crescent, S.E.9.

Huddersfield S.M.E.

The annual general meeting was held on May 26th, when it was reported that the society had had another successful year and was in a sound financial position.

Good weather favoured us for the Open Day held on April 30th, and we have optimistically arranged other events to take place at the Highfields centre as follows:

July 3rd.—Open Day.

July 31st.—Open Day with special boating events.

September 17th and 18th.—Weekend for visiting clubs.

The railway track will be erected as usual in Greenhead Park for the summer entertainments period, July 16th to August 20th inclusive. A power boat regatta will take place during the evening of August 20th on the Park lake. Visitors welcomed to all the above events.

Hon. Secretary: H. Deacon, 291, Blackmoorfoot Road, Crosland Moor, Huddersfield.

Cape Town Society of Model and Experimental Engineers

At the recent annual general meeting, the officers and committee were elected to serve for the next twelve months.

We would like to extend an invitation to any modeller visiting South Africa to get in touch with us and meet us.

Hon. Secretary: J. Pearson, P.O. Box 2430, Cape Town.

The Gauge "1" Model Railway Association

At the annual general meeting held in May, the Earl of Northesk was re-elected president. Mr. F. R. Kaye was elected chairman, and Messrs. W. G. Kelly, J. T. van Riemsdijk and S. J. Roberts were re-elected treasurer, secretary and assistant secretary respectively. Following the business, members enjoyed a running session on the association's track, which was erected for the occasion.

Members near London staged a successful Track Night at the Model Railway Club's meeting on May 26th. The steam boys were represented by Mr. Herring with his coal-fired G.N. Atlantic, and by Mr. Wrighton with his ever-willing G.E. 1500; and a good selection of electrically-driven models was also run.

It is hoped that there will be some get-togethers on various members' lines during the summer; details of these will be circulated to members.

The association continues its efforts to publicise and promote co-operation in Gauge "1," and all enthusiasts are invited to contact the Hon. Secretary: J. T. van Riemsdijk, 40, Bancroft Avenue, London, N.2, for details of the association and its activities.

North London S.M.E.

The society's A.G.M. passed off quite uneventfully. With the exception of a new secretary, things are much as they were, and our membership keeps steady.

The locomotive sections have been quick off the mark this season and one joint effort with the Romford Club at the Chipperfield track, which must be one of the best in the country, proved a very enjoyable affair. Locomotives were steaming up all over the place and it must be a long time since so many assembled all at once there. It certainly was a magnificent sight to see Mr. Otley's 5-in. gauge S.A.R. entering and emerging from the tunnel.

Our workshop in Prospect Road is taking shape, and section meetings are now held there.

The Loco Section expect to entertain the S.M.E.E. in the near future at Arkley. May we repeat that Visitors' Day there is every second Sunday in each month.

Plans are afoot to extend the track by another 800 feet; the present track is 493 feet, and we hope this dream comes true.

Hon. Secretary: D. G. Gordon, 60, Victoria Road, New Barnet, Herts.

THE MODEL ENGINEER DIARY

June 25th.—Bristol Society of Model and Experimental Engineers.—Public day at the track, Canford Park.

June 25th and 26th.—The West Riding Small Locomotive Society.—Rally of Model Locomotives, Gauges $2\frac{1}{2}$ in. to $7\frac{1}{4}$ in., at Blackgates House, Bradford House, Tingley, Wakefield. Open from 10 a.m. to 10 p.m. both days.

June 26th.—Victoria Model Steamboat Club.—Regatta at Victoria Park, Hackney, London, E.9. Starting at 11.0 a.m.

July 3rd.—Wicksteed Model Yacht and Power Boat Club.—Regatta at Wicksteed Park, Kettering. Starting at 11.30 a.m.

July 3rd.—Bromley Model Power Boat Club.—Regatta at Whitehall Recreation Ground, Bromley, Kent. Starting at 11.0 a.m.

July 9th.—Vickers-Armstrongs Limited (Weybridge) Model Club. Annual exhibition, at Vickers-Armstrongs Limited, Sports Ground, Kings Head Lane, Byfleet, Surrey.

July 10th.—Wallasey Model Power Boat and Yacht Club.—Regatta at Central Park, Wallasey. Starting at 11.30 a.m.

July 10th.—Model Power Boat Association.—Radio Control Regatta at Victoria Park, Hackney, E.9. Starting at 11.0 a.m.

July 17th.—Southend Model Power Boat Club.—Regatta at Southchurch Park, Southend. Starting at 11.0 a.m.

July 24th.—Bedford Model Yacht and Power Boat Club.—Regatta at Longholme Lake, Bedford (provisional). Starting at 11.0 a.m.

July 24th.—Brighton and Hove Society of Model Engineers.—Regatta on Hove Lagoon. Starting time 11.0 a.m.

July 30th.—St. Albans and District Model Engineering Society.—Regatta at Verulamium, St. Albans. Starting at 2.0 p.m.

July 31st.—Model Power Boat Association.—National Speed Regatta at Verulamium, St. Albans. Starting at 12.30 a.m.

August 9th, 10th, 11th, 12th and 13th.—Weymouth & District M.E.S.—Exhibition of models, at the Melcombe Regis Boys School, Weymouth. Open from 11.0 a.m. to 9.0 p.m. daily.

August 10th, 11th, 12th and 13th.—Exmouth and District S.M.E.E.—Exhibition at the Y.M.C.A. Hall, Victoria Road, Exmouth. Open at 7.30 p.m. on August 10th. Remaining days open from 10 a.m. to 9 p.m.

August 10th, 11th, 12th and 13th.—Isle of Wight Model Engineering Society.—Annual exhibition at the Secondary Grammar School, Nodehill, Newport, I.W. Open on Wednesday, Thursday and Friday from 2.30 p.m. to 9.0 p.m., Saturday 10.30 a.m. to 9.0 p.m.

August 17th, 18th, 19th, 20th, 22nd, 23rd, 24th, 25th, 26th and 27th.—The Model Engineer Exhibition, in the New Horticultural Hall, Greycoat Street, Westminster, S.W.1. Open from 11 a.m. to 9.0 p.m.

September 17th.—Guildford Model Engineering Society.—Annual exhibition at St. Saviour's Hall from 11.0 a.m. to 9 p.m.

CORRESPONDENCE

The Managing Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Correspondence and manuscripts should not be addressed to individuals, but to the Managing Editor, The Model Engineer, 19-20, Noel Street, London, W.1.

Private: 3d. per word. Trade: 6d. per word. Minimum 12 words. Use of box 1s. 0d. extra.

THE MODEL ENGINEER

Rates for displayed advertising in this section 35s. per single column inch 1$\frac{5}{8}$ inch wide.

CLASSIFIED ADVERTISEMENTS

The Advertisement Manager reserves the right to refuse or suspend advertisements without giving any reason. No definite date of insertion can be guaranteed. Every care is taken to avoid mistakes, but the publishers cannot be held liable in any way for printing errors or omissions. Receipt of "copy" for publication implies acceptance of these conditions by the advertiser. Whilst every care is taken to exclude advertisements from doubtful sources, no responsibility can be accepted by the publishers for the bona fides of advertisers.

WORKSHOP EQUIPMENT

Buck & Ryan for Lathes and Accessories, drilling machines, grinders, electric tools, surface plates, etc.—310-312, Euston Road, London, N.W.1. Phone: Euston 4661.

For Your Myford M.L.7. 5-station turret attachment with novel features. Price £14 10s. 0d. or deposit £2 10s. 0d. and twelve monthly payments of £1. S.A.E. for descriptive leaflet.—Wanstead Supply Co., 48, High Street, London, E.11.

"Acorntools" and "Acorntools" De Luxe 5" s.s. and s.c. lathe, also "Acorntools" 7" stroke high-speed shapers and $\frac{1}{2}$" capacity capstan lathes can be supplied *ex*-stock. Hire purchase terms available. Send for literature and all details to the manufacturers of these machines.—The Acorn Machine Tool Co. (1936) Ltd., 610-614, Chiswick High Road, Chiswick, W.4. Tel.: 3416-7-8-9.

Immediate Delivery from Stock. Myford "M.L.7" and "Super 7" lathes, Grayson, Super Adept lathes, bench planers, shapers, electric motors, small tools.—F. W. Kubach, 12, Sylvan Road, London, S.E.19. LIV. 3311/12.

Whiston for Nuts, Bolts, etc., rivets, 1/32" dia. up, plastic belt, silver-solder, silver-steel, screwed rod, ball-races, etc., Send for 1,000 items list.—K. R. Whiston, (Dept. M.E.S.), New Mills, Stockport.

Rebuilt Lathes. The Acorn Machine Tool Co. (1936) Ltd., offer rebuild to limits "Acorntools" and "Atlas" 10" swing s.s. available. Write—610-614, Chiswick High Road, W.4. (Phone: CHI 3416.)

Take a Tip! It may be "Wimet." Grind with "Diadisc" from Millett! 1$\frac{1}{4}$" diamond lap, $\frac{1}{2}$" taper bore, 25s. 9d.—W. J. Millett, C.M.B.H.I., St. Ives, Huntingdon.

Perfecto Engineering Co. (Machine Tools). Hoover motors, Burnerd chucks, cash or terms. 20 D.P. gears suitable for most types of popular lathes. Castings, etc. for our 4" lathe, 5" stroke power shapers. Lists 6d.—60, Stanley Street, Leicester. Phone: 20078.

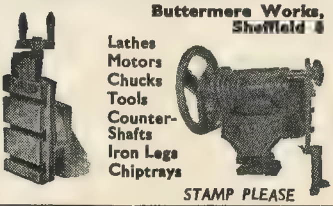
Wanted. Atlas, Halifax, Sphere or similar lathes. Please state condition and list equipment.—Box No. 7666, Model Engineer Offices.

Practical Armature Winding, by A. H. Avery, A.M.I.E.E. Few books deal with the purely practical side of armature winding and the pitfalls to be avoided and so this manual meets a definite need. 3s. 6d. from your bookseller, or 3s. 9d. from—Percival Marshall & Co. Ltd., 19-20, Noel Street, London, W.1.

Wanted. $\frac{1}{2}$" Capacity drilling machine, belt drive or motorised 230 volt, bench or pedestal type.—Box No. 7748, Model Engineer Offices.

Black & Decker Drill U.1., £5 2s. 6d. Drill stand, £3, other accessories. Guaranteed new and unused.—Hallchurch, 29, Sixth Avenue, Bristol 7.

CHARLES PORTASS & SON
Buttermere Works, Sheffield 8



Lathes
Motors
Chucks
Tools
Counter-Shafts
Iron Legs
Chiptrays

STAMP PLEASE

Mail Order Only. Brand new tools. Bargain price. Post free. Lathe chuck specialist, Independent, 4", 60s; Burnerd, 3$\frac{1}{4}$", 67s. 6d.; 4$\frac{1}{2}$", 75s.; 6", £6 4s. 6d. Burnerd self-centring 3-jaw, 2$\frac{3}{4}$", £6 15s. 0d.; 3$\frac{1}{4}$" £7 16s. 9d.; 4", £7 16s. 9d.; 5", £9 17s. 3d.; 6", £11 8s. 9d.; 9", £17 1s. 3d. Micrometer, 1", 10s. Angle plate, 3", 5s. 3d. Vee block, 3", 5s. 3d.; 4", 6s. 6d. 3 lathe carrier, $\frac{1}{2}$", $\frac{3}{4}$", 1", 11s. 6d. Burnerd toolpost for 3$\frac{1}{2}$" lathe, £7 5s. 0d.; 4$\frac{1}{2}$"-5" lathes, £9 6s. 0d. Machine vice, 18s. 6d. Union hand bench drilling machine $\frac{1}{2}$", £5 6s. 6d. Steel dieholder, $\frac{13}{16}$", 2s. 9d.; 1", 6s.; 1$\frac{5}{16}$", 10s. Carb. wheel, 4" × $\frac{1}{4}$", 4s.; 3$\frac{1}{2}$" × $\frac{3}{4}$", 4s.; 7" × $\frac{1}{2}$", 7s. 6d., all $\frac{3}{4}$" hole. Ratchet brace 10" sweep, 16s. 6d. Twist drill grinding jig to $\frac{1}{2}$", 24s. Precision drill chucks, $\frac{1}{2}$", 38s. Arbors for same, No. 1 M.T., 5s. 6d., 2, 6s. Drill stands, 1-60, $\frac{1}{16}$"-$\frac{1}{2}$", A-Z, 3s. 9d. each. Dies $\frac{13}{16}$" dia., 40 t.p.i., 5/32", $\frac{3}{16}$", 7/32", $\frac{1}{4}$", each 2s. 9d. B.A. 0-1-2-3-4-5-6, 2s. 2d.; 7-8, 2s. 9d.; 9-10, 3s. 6d. Silver-steel round 13" lengths, 12 different sizes, 1/32" to $\frac{3}{16}$", 10s. H.S. centre drills, size 1, 2s.; 2, 2s. 3d.; 3, 2s. 9d.; 4, 3s. Abrafiles, 8d. Links, 2, 4d. Tailstock dieholder, $\frac{13}{16}$", No. 1 M.T., 13s. 6d. H.S. twist drills 1-2, 2s. 6d. each; 3-6, 2s. 5d.; 7-11, 2s. 1d.; 12-16, 1s. 11d.; 17-19, 1s. 10d.; 20-24, 1s. 9d.; 25-29, 1s. 8d.; 30-32, 1s. 8d.; 33-42, 1s. 4d.; 43-48, 1s. 3d.; 49-52, 1s. 2d.; 53-70, 1s.; 71-75, 1s. 6d.; 76-80, 1s. 11d.; $\frac{1}{16}$", 1s. 2d.; $\frac{1}{8}$", 1s. 5d.; 5/32", 1s. 10d.; $\frac{3}{16}$" 2s.; 7/32", 2s. 6d.; $\frac{1}{4}$", 3s. 1d.; 9/32", 3s. 10d.; $\frac{5}{16}$", 4s. 6d. Adjustable spanners, 9", 6s. 3d.; 11$\frac{1}{2}$", 7s. 8d. H.S. tool bits, square, $\frac{3}{16}$", 1s. 2d.; $\frac{1}{4}$", 1s. 9d.; $\frac{5}{16}$", 2s. 7d.; $\frac{1}{2}$", 5s. 6d.; $\frac{5}{8}$", 8s. 6d. Tap 40 t.p.i., 5/32", $\frac{3}{16}$", 7/32", $\frac{1}{4}$", 1s. 9d. each; 32 t.p.i., $\frac{5}{16}$", 2s. 4d.; $\frac{3}{8}$", 2s. 7d.; B.A. 0-1-2-3-4-5-6, 1s. 1d.; 7-8, 1s. 3d.; 9-10, 1s. 9d. 26 t.p.i. $\frac{5}{16}$", 1s. 7d. Whit. $\frac{1}{16}$", 1s. 8d.; 3/32", 1s. 8d.; $\frac{1}{8}$", 1s. 2d.; $\frac{1}{4}$", 11d.; $\frac{5}{16}$", 1s. 3d. B.S.F. $\frac{1}{4}$", 11d.; $\frac{5}{16}$", 1s. 3d. Your address block letters.—S. Grimshaw, 7, Hall Street, Gorton, Manchester, 18.

Wanted. Engraving Machine. M.L.7 attachments MA68/1, 1467, 1468, 3-jaw chuck.—May, Ferndale, Gipsy Lane, S.W.15.

Winfield Centre Lathe, two chucks, countershaft, motor, vertical-slide, accessories. $\frac{1}{4}$" vertical bench drill.—Smollett, 61, Kilmaurs Street, Glasgow, S.W.1.

Wanted. Swivel Vertical-slide for 3$\frac{1}{2}$" lathe, also double ended grinder 6" minimum. Prepared to buy machine that can be rewound or repaired. State defects. —Phones: day, Ealing 7051; evening Uxbridge 3304.

M.L.4 Chucks, stand, tray, c.s., etc., £20. German lathe 2$\frac{1}{4}$", 11", £8, or exchange $\frac{1}{2}$" pillar drill, shaper.—Box No. 7761, Model Engineer Offices.

Lathe Chucks, 5" s/centre, £5 10s. 0d. 3" lever scroll, £3 10s. 0d. 4" independent, £2 10s. 0d. All as new. 3-speed bench drill, $\frac{1}{2}$" cap., motorised, 230/250 volt, 1-phase, perfect, £13 10s. 0d.—W. Moldon, 35, Ealing Village, London, W.5.

Winfield 4$\frac{1}{2}$" B.G.S.C. Lathe, chucks countershafting, $\frac{1}{4}$ h.p. motor, £28.—23 Oaklands Avenue, Loughborough, Leics.

3$\frac{1}{2}$" "Faircut" Lathe. B.G.S.C. gap-bed, countershaft, 1/3 h.p. Metro-Vickers motor, chuck and numerous tools.—Phone: Springpark 1569.

12" Electric Fan, 230 volts, d.c., 50s. $\frac{1}{4}$ h.p. Crompton Parkinson electric motor, 230 volts, d.c., £4. Several rotary files and tool bits cheap.—14, St. Dunstans Street, Canterbury.

Cleveland Automatic Lathe, $\frac{5}{8}$" capacity, three operation, £35. Humphris 12-ton power press, 400/3/50, £50. Denbigh milling machine 18" × 5", table £35. 6" I.X.L. screwcutting lathe, £30. No. 4 fly press, £10. Swiss type two spindle automatic 8 mm. capacity, 400/3/50, £45.—Scott, 9, Camden Mews, London, N.W.1. Gulliver 4330.

Air Compressor sliding vane type, requires no cylinder, immediate and continuous airflow, 3 c.f.m., 30 lb. pressure. Ideal for spraying, decorating, brazing and general workshop use. Brand new units complete with all machined parts, pulleys, filters, relief valve, "V" belt, etc., and instructions for mounting on your motor. Only simple tools necessary. These are guaranteed precision built with ball-race bearings throughout. Price 70s. Units fitted to new 1/3 h.p., 220/240/1/50 motors available, price £10. Seen working anytime.—Glover, 6, Haywood Rise, Orpington, Kent. Telephone Farnborough 3957.

Clearance Owing to Advancing Years. Drummond 4" treadle lathe. Foster 5$\frac{1}{2}$" short plain D.O. George Adams 3" screw-cutting. 1$\frac{1}{2}$ h.p. Crossley engine. Small sensitive drill. Prices low. Buyers collect.—Telephone 12553 or s.a.e., 4, Hilda's Grove, Lee-Smith Street, Hull.

Lathe, Sander and Polisher, 14" between centres, complete, new, £7 10s. 0d. Sawbench grindstone, circular saw, 6" dia., 1/3 h.p. Brook motor, new, £12 10s. 0d.—M. M. McMahon, "Wendy," Charmouth Dorset.

Flexispeed 1$\frac{5}{8}$" Lathe, auto traverse, c'shaft, chucks, steady, tools, Brookes $\frac{1}{4}$ h.p. motor, $\frac{1}{4}$" hand bench drill, all as new, £12 10s. 0d. lot.—Draper, "Mansfield," Bottom O'th Moor, Bolton, Lancs.

Myford M.F.30. 4" B.G.S.C., motorised, on angle-iron stand, good condition, £45 o.n.o.—J. W. Harvey, 14, Delph Crescent, Clayton, Bradford. Yorks.

Myford M.L. 7. 3$\frac{1}{2}$" × 20" with cabinet, change-wheels, 3- and 4-jawed chucks, steady, die-holders, boring bar, carriers, lathe tools, angle-plates, $\frac{1}{2}$" drill chuck. Less than 10 hours work, £70. Evenings.—Blair, 5, Hormead Road, London, W.9.

Wood Carving Chisels, 18 and 4 punches, in felt lined box, pre-war, unused, £6 10s. 0d.; 20" paper cutting "Jaynay," £2 10s. 0d.—Lees, The Cottage, Claremont Road, Gloucester.

MODELS AND FITTINGS

Motor Tug. S. A. Everard prototype cup winner, 5' 30 c.c. engine, good offer.—BROWN, 44, Forest Drive, Theydon Bois.

New 4-6-0 7¼" Gauge "Royal Scot," 1,000' track, coaches, etc., for sale.—Box No. 7759, MODEL ENGINEER Offices.

"Seal" 15 c.c. just completed by toolmaker, £35.—Box No. 7752, MODEL ENGINEER Offices.

Working Model Triple Expansion marine engine, suit technical college, £150. Particulars, write.—L. SEVERN, 59, Denby Lane, Codnor, Derby.

Models in Bottles by R. F. C. Bartley. In addition to modelling ships in bottles the author shows how the art can be extended to include the "bottling" of windmills, stage coaches, scenes from fairy tales, etc. 7s. 6d. from your booksellers or model shop or 8s. post free from—PERCIVAL MARSHALL & Co. LTD., 19-20, Noel Street, London, W.1.

For Sale. 3½" Gauge "Bantam Cock," £50. Partly made 3½" gauge "Invicta" with all materials to complete, £10. 250 "Model Engineers," £2 10s. 0d.—R. NEWNHAM, 95, Grange Road, Guildford, Surrey.

Wanted. Model Stationary Steam Engine, with or without boiler and dynamo.—WATSON, 6, Regent Terrace, Doncaster.

Wanted. 5" Gauge passenger cars or bogies.—HARPER, 35a, Westmoreland Road, Bromley, Kent.

10¼" Gauge L.N.E.R. type "Pacific," copper boiler. Perfect condition. Offers.—Box No. 7764, MODEL ENGINEER Offices.

SITUATIONS

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive or a woman aged* 18-59 *inclusive unless he or she or the employment, is excepted from the provisions of the Notification of Vacancies Order,* 1952.

Sales Engineer Having Purchased Small Factory, Chertsey, Surrey, requires competent all-round practical machinist tool-maker, together with high-grade fitter for machine tools and engines on working partnership basis. Salary and output bonus and share holding gratis after satisfactory trial, apply with full details experience, age, etc., will to work and general "know how" essential.—Box No. 7749, MODEL ENGINEER Offices.

ELECTRICAL

A.C. Motors Capacitor Start induction, 200/250 volts, 50 cycles, 1 phase, 1,425 r.p.m., ¼ h.p., £3 12s. 6d.; 1/3 h.p., £4 17s. 6d., ½ h.p., £6 10s. 0d. Perfect and guaranteed. Passenger carriage, 5s.—JOHNSON ENGINEERING COMPANY, 319, Kennington Road, S.E.11. Reliance 1412/3.

House Service Meters, 220/250 volts, (a.c. or d.c.). Credit or prepayment type.—UNIVERSAL ELECTRIC Co., 220, City Road, London, E.C.1.

Electric Motors, generators, starters, ⅛ to 40 h.p., a.c. or d.c., 100-350 volt, switches, cables, electric tools. Exchanges.—VERNON SMITH LTD., 354/366, King Street, London, W.6. RIV 3964.

Everybody's Book of Electricity, by R. Barnard Way. A friendly little book, without mathematics or text book theory for all interested in electricity. Gives an introduction to the principles of electricity and a simple explanation of modern appliances and machines. 3s. 6d. from your bookseller or 3s. 9d. post free from—PERCIVAL MARSHALL & Co. LTD., 19-20, Noel Street, London, W.1.

¼ h.p. Motor for sale, good condition, £2 10s. 0d.—F. WILLIAMS, 304, Liverpool Road, Islington, London, N.7.

Three-core 23/36 Cir. Braided Flex, DV (CMA) maroon/white tracer, 58s. 100 yd., plus postage; 3-core 40/36 braided flex DV (CMA) maroon/white tracer, 67s. 6d. 100 yd.; 3-core 23/36 non-kink (50 ft. coils), 70s. 100 yd., plus postage.—D. L. ELECTRICAL ACCESSORIES, 37, London Road, Mitcham Surrey. Phone MITcham 1925.

GENERAL

"Spraying Handbook" 1950 ed. Car, caravan, industrial, domestic stoving, flock leather spraying, 3s. 6d. post free.—LEONARD BROOKS, 25, Harold Wood, Romford.

Compressor Equipment, miscellaneous items, etc., catalogues, 1½d.—PRYCE, 157, Malden Road, Cheam.

Guaranteed ! Easy Home Constructed Refrigeration. Genuine domestic components. Not second-hand ice cream scrap. Modern hermetic G.E.C. units. Gas, electric and oil silent units. Everything for refrigeration. Complete specialists. Send s.a.e. for free illustrated "Sealed System" leaflet or 1s. for complete catalogue (refunded with first order).—BRAID BROS., 50, Birchwood Avenue, Hackbridge, Surrey. Phone: Wallington 9309.

Watch and Clock Lathes, cleaning machines, staking tools, etc. (Large illustrated catalogue, 1s. 6d. p.p. Price list 1s. 1d. p.p.) Watch and Chronograph repairs and materials for the trade. SPECIAL OFFER: New (slightly shop-soiled) 3" (U.S.A.) Bezel chucks (8 mm.), £5 1s. 9d. post paid. (Used lathes bought, sold and part-exchanged.) Easy payment terms available.—JOHN MORRIS (CLERKENWELL) LTD., 64, Clerkenwell Road, London, E.C.1.

Air Compressor Units, 2¼ to 18 cu. ft. 100 to 800 p.s.i. from £4 17s. 6d. Stationary and mobile plants from £16 17s. 6d.—Below.

Air Tanks and Accessories at approximately 50 per cent. off lists.—Below.

TV Generators and Lighting Sets "Chorehorse" BD-12-A, £47 10s. 0d. "Onan" relays starting from £37 10s. 0d. "Homelite," £35 0s. 0d., etc., all with d.c. output. Straight d.c. lighting sets "Delco" £16 10s. 0d. Johnson "Chorehorse," £25. "Homelite" 24 volt, 2,000 watts, £27 10s. 0d—TEDDINGTON ENGINEERING CO. LTD., Dept. G., 29/31, High Street, Teddington, Middx. KINGston 1193.

Compressors for Sale. Twin-pistons complete with air receiver, driving wheel and motor cradle, 180 lb., 2¼ cu. ft., price, £3. Also 8 cu. ft. compressor only, £5. Motors a.c. and d.c. all types, ¼ h.p., £3. Carriage forward.—WHEELHOUSE, 1, The Grove, Isleworth, Middx. Phone: Hounslow 7558.

"Aqualung" Cylinders, £2 2s. 6d. Regulators, £1 16s. 9d. Compressors, £4 10s. 0d.—PRYCE, 157, Malden Road, Cheam.

Musical Mechanisms. Swiss-made for fitting in cigarette boxes, etc., 17s. each. Send s.a.e. for complete list of handicraft materials.—METWOOD ACCESSORIES, Dept. M.E., Church Street, Wolverton, Bucks.

How To Build That Garage Workshop, by T. E. Dutton. Full details for constructing a building which can be used both as a garage and a workshop. 5s. from your bookseller, 5s. 6d. post free from—PERCIVAL MARSHALL & Co. LTD., 19-20, Noel Street, London, W.1.

Easy to Make Clutch Unit Drawings, instructions, all parts only 68s. 6d. Leaflet free.—P. B. ENGINEERING, 86, King William Street, Coventry.

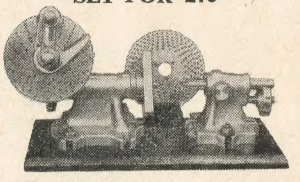
Build Your Own Refrigerator. All components available at reasonable prices. Frigidaire, "Flowing Cold" units, £5; small single-cylinder units, Kelvinator, etc., £4; ¼ h.p. heavy duty motors, £3. Chrome cabinet fittings new, £4 set. Money back guarantee. S.A.E. for list and schematic diagram.—WHEELHOUSE, 1, The Grove, Isleworth, Middx. Hounslow 7558.

Item 3040 Electric Priming Pump. 24 volt, powerful motor geared 4-1 to small rotary sliding vane type pump. With pump removed, could be used as geared motor for small drill, etc., 25s. each. Also many other interesting items. S.A.E. for list.—HULSE & GODDARD, Buxworth, Stockport.

B.M. Steel Rounds. ⅛" dia., 2d.; 3/16", 2d.; ¼", 3d.; 5/16", 3d.; ⅜", 5d.; 7/16", 7d.; ½", 9d.; ⅝", 1s. 2d.; ¾", 1s. 9d.; ⅞", 2s. 4d.; 1", 3s. 1d. 1¼", 4s. 9d.; 1½", 6s. 9d.; 1¾", 8s. 6d.; 2", 12s. 6d. per ft., post extra. S.A.E. for list.—B. J. HARRIS, The Cottage, Corngreaves Hall, Cradley Heath, Staffs.

Wanted. American Communications Receiver, converter for 10, 15, 20 meters with modern valves, 2 meter xtal controlled converter, final valve for 150 watt on 2 meters.—CAFE, Walsall Road, Aldridge, Staffs.

A PRECISION DIVIDING SET FOR £10



S.A.E. for full details

WINCHESTER ENGINEERING Co. Ltd.
Sheephouse Farm, St. Anne's Road, London Colney, Herts
Phone Bowmans Green 3248

Aerograph Portable Compressor Twin Cylinder, 6 c.f. with 1 h.p., 3-phase motor receiver, airfilter 20 to 30 ft. air line. Ben spray gun, £25; 2 Reavel air compressors, twin cylinders, 5.1 c.f., £4 10s. 0d. each; Wolf ¼" electric drill with polishing set grinding set and drill stand, £6; plumbers and engineers stocks and dies, etc.—46, East Bath Street, Batley, Yorks.

Wire. Assorted Bundles round, sq., and hex. wire sizes. Approx. 1 cwt., 4 ft. lengths, £1 each. Delivered free London area.—MACREADY'S METAL Co. LTD., 131/5, Pentonville Road, N.1.

For Sale. Unused 2⅝ Flexispeed lathe with c/shaft., self-acting, £10 o.n.o.—65, Kinson Park Road, Bournemouth.

"Model Engineers" unbound, Jan. 1946 to date less vol. 102. Photographic or other exchange.—30, Russell Avenue, Wollaton, Nottingham.

Photo-multiplier 27M1, photo-cells, 90 AV, new, boxed; also valves, etc., details—STRATTON, 42, Crescent Road, Worthing, Sussex.

Exchange. Hambander plus R103A or R1155A, good condition, for Eddystone 5640, etc., or Hallicrafters SX24 or SX25 or sell Hambander. Offers.—NUNN, Hartslock View, Lower Basildon, Berks.

Inventions Marketed. Ideas developed, drawings prepared. Send now for particulars.—Box No. 7762, MODEL ENGINEER Offices

Wanted. Model Engineer Familiar Live Steam locomotive work undertake machining 3½" cylinders, etc. Details—Box No. 7763, MODEL ENGINEER Offices.

Sale. "M.E.s" vols. 102 to 111, £2 10s. 0d.—GREENHILL, 68, Primrose Lane, Birmingham, 28.

Diesel Engine, Coventry Victor, 7/9 h.p., portable, in good running order, £50.—R. FLETCHER, Whepstead, Suffolk.

Astronomical Telescopes, 115s. Construction kits, 57s. 6d. Eyepieces 50 × 80 × solar and polarised from 25s. Star charts, books, planispheres, etc. Stamp for full particulars and lists.—J. K. M. HOLMES, Scientific Instrument Makers, Dept. M.E., 65, Stephenson Street, North Shields, Northumberland.

*m*m*m*m*m*m*m*m*m*m*m*m*m*m* m*m*m*m*m* m*m*m*m*m*m *m*m*m*m*m* m*m*m*m*m*m*m*

MICROMETERS SLIDE GAUGES & CALIPERS

3s. 0d.

CONTENTS

- Simple and Registering Calipers
- Slide Gauges
- Vernier Scales and how to use them
- Micrometer Slide Gauges
- Details of Micrometer Construction
- How to read the Micrometer
- Some examples of Modern Micrometers
- The use of Measuring Instruments

No mechanic, however skilful, can work to a higher accuracy than that of his measuring instruments. This book does not presume to be a scientific treatise, but is intended as an introduction to the principles, construction, operation and use of measuring instruments by engineers who wish to know and use their equipment to the best advantage.

By Alfred W. Marshall, M.I.Mech.E., and George Gentry, enlarged edition, 78 pp.

PERCIVAL MARSHALL & CO LTD · 19-20 Noel St · London W.1

*m*m*m*m*m*m*m*m*m* m*m*m*m*m* m*m*m*m*m* m*m*m*m*m*m *m*m*m*m*m*m*m*m*m*m*m*m*

THE MODEL ENGINEER

CLASSIFIED ADVERTISEMENTS

- PRIVATE RATE 3d. A WORD
- TRADE RATE 6d. A WORD
- MINIMUM 12 WORDS
- BOX NUMBER 1/- EXTRA

To "THE MODEL ENGINEER" Classified Advertisement Dept., 19-20, Noel Street, London, W.1.

Please insert the advertisement below under

heading............................for............................insertions

Name ....

Address ....

Name and address, if to appear, must be paid for.

....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....

Three insertions for the price of two. ★ Private advertisers only.

Please write in block letters. REMITTANCE VALUE .... ENCLOSED

Printed in Great Britain for the Proprietors by Electrical Press Ltd., Cordwallis Works, Maidenhead, Berks, and published by Percival Marshall & Co. Ltd., 19-20, Noel Street, London, W.1.
Registered for transmission by Magazine Post to Canada including Newfoundland.